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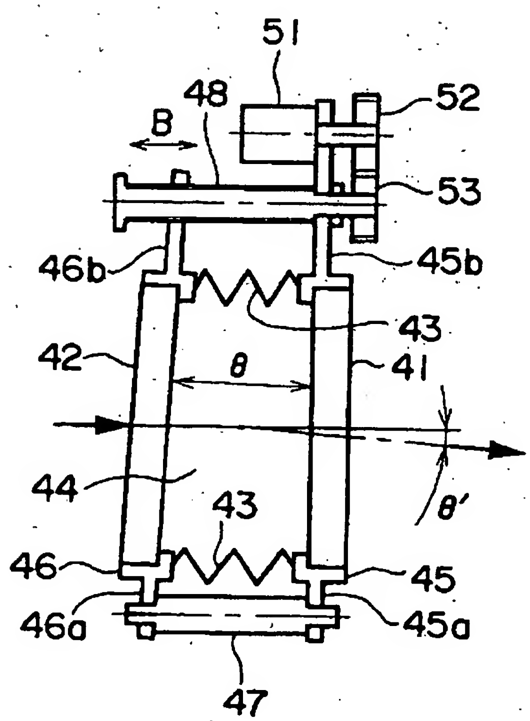
(54)【発明の名称】レーザ測量装置

(57)【要約】
【課題】　整準のための構造を簡単にすることができ、しかも整準作業を短時間で行うことができるレーザ測量装置を提供する。
【解決手段】　弾性体からなる蛇腹状のカバー４３は、２枚の略平行ガラス４１，４２によって封止されており、カバー４３内部は液層４４が充填されている。略平行ガラス４２を保持するガラス押さえ枠４６に形成されたリードネジ保持部４６ｂは、リードネジ４８に螺合している。モータ５１が回転されることにより、リードネジ４８が回転し、これに伴い、リードネジ保持部４６ｂが図中Ｂ方向に進退移動される。これによって、液層４４の頂角θの大きさが変化し、２枚の略平行ガラス４１，４２を透過するレーザビームのビーム軸の向きは、この頂角θの大きさに応じて屈折される。



【特許請求の範囲】

【請求項1】レーザ光源と、
前記レーザ光源から出射されたレーザビームの光路上に配置された略平板状の第1および第2透明部材と、
前記第1および第2透明部材によってその両開口縁が封止された筒状の弾性部材と、
前記弾性部材内に液体が充填されることにより形成された液層と、
前記第1および第2透明部材を保持する鏡筒と、
この鏡筒に保持された前記第1および第2透明部材の相対的傾斜角を、平行を含む範囲で調整可能とする調整機構と、
前記鏡筒の水平面に対する傾斜角を検出するレベル検知器と、
前記レベル検知器によって検出された前記傾斜角の大きさに応じて前記調整機構を制御し、前記第1透明部材と前記第2透明部材のなす角の大きさを調整する制御手段とを備えるレーザ測量装置。

【請求項2】前記弾性部材は蛇腹状の形状を有している請求項1記載のレーザ測量装置。

【請求項3】前記液層を形成する液体はシリコーンオイルである請求項1記載のレーザ測量装置

【請求項4】前記第1および第2透明部材を透過したレーザビームを９０°偏向する反射部材と、
前記反射部材を回転させることによりこの反射部材によって偏向されたレーザビームの出射方向を一定平面内で回転させる回転手段とをさらに備える請求項1ないし請求項3のいずれかに記載のレーザ測量装置。

【請求項5】前記レーザ光源から出射されたレーザビームを２以上のレーザビームに分割するビーム分割手段と、前記ビーム分割手段によって分割されたレーザビームのうちの１つを集光する集光レンズと、前記集光レンズの焦点面上に配置され、前記集光レンズによって集光されたレーザビームの入射位置を検知する光位置検出手段とをさらに備え、
前記制御手段は前記第1透明部材と前記第2透明部材のなす角の大きさを前記光位置検出手段に入射した前記レーザビームの入射位置の変化量に基づいて算出する請求項1ないし請求項3のいずれかに記載のレーザ測量装置。

【請求項6】レーザ光源と、
このレーザビームのビーム軸を中心として回転可能に鏡筒内に保持されるとともに前記レーザ光源から出射されたレーザビームを透過する第1楔ガラスと、
前記レーザビームのビーム軸を中心として回転可能に鏡筒内に保持されるとともに前記第1楔ガラスを透過したレーザビームを透過する第2楔ガラスと、
前記鏡筒に保持された前記第1および第2楔ガラスを回転させる回転機構と、
前記鏡筒の水平面に対する傾斜角を検出するレベル検知器と、
前記レベル検知器によって検出された前記傾斜角の大きさに応じて前記回転機構を制御し、前記第1および第2楔ガラスを透過するレーザビームの出射方向を調整する制御手段とを備えるレーザ測量装置。

【請求項7】前記第1および第2楔ガラスを透過したレーザビームを９０°偏向する反射部材と、
前記反射部材を回転させることによりこの反射部材によって偏向されたレーザビームの出射方向を一定平面内で回転させる回転手段とをさらに備える請求項6記載のレーザ測量装置。

【請求項8】前記レーザ光源から出射されたレーザビームを２以上のレーザビームに分割するビーム分割手段と、前記ビーム分割手段によって分割されたレーザビームのうちの１つを集光する集光レンズと、前記集光レンズの焦点面上に配置され、前記集光レンズによって集光されたレーザビームの入射位置を検知する光位置検出手段とをさらに備え、
前記制御手段は前記第1および第2楔ガラスの回転を前記光位置検出手段に入射した前記レーザビームの入射位置の変化量に応じて制御する請求項6記載のレーザ測量装置。

【請求項9】前記ビーム分割手段は入射光の一部を透過するとともに残りを反射するビームスプリッタである請求項5または請求項8に記載のレーザ測量装置。

【請求項１０】前記光位置検出手段は２次元ポジション・センシティブ・ディテクタ（ＰＳＤ）である請求項5または請求項8に記載のレーザ測量装置。

【請求項１１】前記ビーム分割手段によって分割されたレーザビームの他の１つを９０°偏向する反射部材と、
前記反射部材を回転させることによりこの反射部材によって偏向されたレーザビームの出射方向を一定平面内で回転させる回転手段とをさらに備える請求項5または請求項8に記載のレーザ測量装置。

【請求項１２】前記反射部材はペンタプリズムである請求項4、7、１１のいずれかに記載のレーザ測量装置。

【請求項１３】前記レベル検知器によって検出される傾斜角は前記ビーム分割手段によって分割されて前記反射部材に入射するレーザビームのビーム軸の鉛直に対する傾きに対応する請求項4、7、１１、１２のいずれかに記載のレーザ測量装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、レーザビームによる基準線を所定の面に対して水平方向または垂直方向に投射するレーザ測量装置に関する。

【０００２】

【従来の技術】従来より、土木、建築などの分野では、水平線や垂直線の墨出しを行うためのレーザ測量装置（いわゆるレーザプレーナ）が使用されている。このレ

ーザ装置はレーザ光を出射する投光部を回転させてこのレーザ光を周方向に走査し、レーザ光の軌跡によって壁面などの被投射面に垂直または水平方向の基準線を投射するものである。

【0003】図１２は、従来のレーザ測量装置の構成を示す断面図である。この図１２は、水平方向へのレーザ光走査を行うためにレーザ測量装置を鉛直方向に立てた状態を示している。ハウジング８１内に納められた鏡筒８２は、レーザ測量装置の中心軸に沿ってその全体を貫通する中空のレーザ光光路８２ｂとこのレーザ光光路８２ｂから直角に分岐した中空のレーザ光光路８２ａとから構成されている。レーザ光光路８２ａ内には、その端面側からレーザダイオード８３，コリメータレンズユニット１０４，アナモプリズム８４が固定されている。そして、レーザ光光路８２ａおよび８２ｂの交点には、直角プリズム８５が固定されている。

【0004】レーザ光光路８２ｂ内には、図１２において直角プリズム８５から上方に向かって、前群レンズ８６および後群レンズ８７が固定されている。鏡筒８２の上端部には、ペンタプリズム８９が納められた略円筒状の回転投光部８８が、レーザ光光路８２ｂに直交する面内で回転自在に固定されている。この回転投光部８８の上端面および側方には、それぞれ開口部が形成されている。

【0005】このような構成のレーザ測量装置において、レーザ光光路８２ａ端面に固定されたレーザダイオード８３からレーザビームL_{11}が出射されると、そのレーザビームL_{11}は直角プリズム８５において回転投光部８８側に９０°屈曲され、前群レンズ８６および後群レンズ８７を透過してペンタプリズム８９に入射する。ペンタプリズム８９に入射したレーザビームL_{11}は、第１反射面８９ａおよびこの第１反射面に対して４５°傾いた第２反射面８９ｂによって漸次反射される。そして、第１反射面８９ａおよび第２反射面８９ｂで反射されたレーザビームL_{11}は、光入射面８９ｄに対して直角をなしている光出射面８９ｃから出射される。

【0006】また、第１反射面８９ａには部分反射膜が形成されている。従って、一部のレーザビームL_{11}がこの第１反射面８９ａを透過し、この第１反射面８９ａ上に固定された楔形プリズム９０を透過して回転投光部８８上端面の開口部から出射される。

【0007】そして、回転投光部８８がレーザ光光路８２ｂに直交する面内で回転されることにより、レーザビームL_{11}は、回転投光部８８の回転軸を中心に回転する。従って、この回転軸に直交する基準平面がレーザビームL_{11}により形成される。また、回転投光部８８の上端から出射されるレーザビームL_{11}は天井などに測量基準点などを示すための基準スポットを形成する。

【0008】このように、レーザ測量装置から出射されたレーザビームL_{11}は、壁面などに基準平面を形成するため、正確に水平に出射される必要がある。同様に、天井等に基準スポットを形成するレーザビームL_{11}も正確に鉛直に出射される必要がある。よって、レーザ測量装置の使用時には、レーザビームL_{11}が正確に水平方向に出射されるように、整準作業を行う必要がある。

【0009】以下、レーザビームL_{11}が正確に水平に出射されるための整準機構を説明する。鏡筒８２の上端側には、半球面形状を有する膨出部９１が形成されており、ハウジング８１内に形成された摺動孔８１ａ内に当接した状態で保持されている。鏡筒８２のハウジング８１に対する保持は、この部分の接触によってのみなされているので、摺動孔８１ａ内で膨出部９１の半球面部分を回転させることにより、鏡筒８２全体をあらゆる方向に傾動させることができる。

【0010】また、ハウジング８１内には、レベル調整用モータ９８によって回転されるスクリュー９７が設けられている。このスクリュー９７には、ナット９９が螺合されている。このナット９９はスクリュー９７の回転に伴って上下動される。ナット９９の外面には、作動ピン１０１が突出形成されている。作動ピン１０１には膨出部９１に形成された駆動アーム９６と連通するピン１００が接触しており、これにより、膨出部９１のＸ方向（紙面内での回転方向）の回転が規制されている。

【0011】さらに、鏡筒８２内において直角プリズム８５の下方には、鏡筒８２のＸ方向の傾きを検出するＸ方向のチルトセンサ１０３が固定されている。このチルトセンサ１０３によって検知された傾きに応じてレベル調整用モータ９８の回転制御が行われ、これによって、スクリュー９７が回転される。するとこのスクリュー９７の回転に伴ってナット９９が上下動され、作動ピン１０１およびピン１００を介してリンクされた膨出部９１が、Ｘ方向に回転される。なお、Ｘ方向のチルトセンサの側方には、Ｙ方向（図面中鉛直方向に沿って紙面に直交する面内での回転方向）の傾きを検出するＹ方向のチルトセンサ１０２が固定されている。また、図面中には示されていないが、ハウジング８１内には、チルトセンサ１０２によって検出される傾きの大きさに応じて、膨出部９１のＹ方向の回転を規制するための機構もＸ方向と同様に設けられている。このようにして、鏡筒８２が常に鉛直方向を向くように、すなわち、レーザビームL_{11}が常に水平に出射されるように調整される。従って、レーザビームL_{11}は常に正確な基準面を形成することができる。

【0012】

【発明が解決しようとする課題】しかしながら、上述したような従来のレーザ測量装置の構造では、レーザビームL_{11}を水平に出射させるための整準作業は、レベル調整用モータ９８やスクリュー９７，ナット９９等を用いて鏡筒８２を傾けることにより行われている。このために、レーザ測量装置の構造が複雑になってしまうという

問題があった。

【００１３】また、チルトセンサ１０２，１０３は傾きが変化すると、その測定値が計測可能に安定するまで一定の時間がかかる。このため、従来のように鏡筒８２を傾けることによる調整を行った場合、鏡筒８２の傾きが変化する度にチルトセンサ１０２，１０３の測定値が安定するのを待たなければならない。このため、整準作業を行うために長時間を要していた。

【００１４】そこで、整準のための構造を簡単にすることができ、しかも整準作業を短時間で行うことができるレーザ測量装置を提供することを、本発明の課題とする。

【００１５】

【課題を解決するための手段】上記課題を解決するため、本発明のレーザ測量装置の第１の態様は、レーザ光源と、前記レーザ光源から出射されたレーザビームの光路上に配置された略平板状の第１および第２透明部材と、前記第１および第２透明部材によってその両開口縁が封止された筒状の弾性部材と、前記弾性部材内に液体が充填されることにより形成された液層と、前記第１および第２透明部材を保持する鏡筒と、この鏡筒に保持された前記第１および第２透明部材の相対的傾斜角を、平行を含む範囲で調整可能とする調整機構と、前記鏡筒の水平面に対する傾斜角を検出するレベル検知器と、前記レベル検知器によって検出された前記傾斜角の大きさに応じて前記調整機構を制御し、前記第１透明部材と前記第２透明部材のなす角の大きさを調整する制御手段とを備える。

【００１６】すなわち、第１態様のレーザ測量装置では、弾性部材を第１および第２の透明部材によって封止してその中に液体を充填したユニットを、レーザビームの光路上に配置している。そして、レベル検知器によって検出された鏡筒の水平からの傾きの大きさに応じて、各透明部材のなす角を変化させせることによって、これら各透明部材を透過するビーム軸の向きを変化させている。従って、従来のように、鏡筒を傾ける複雑な整準機構を設ける必要がないため、レーザ測量装置の構造を簡素化することができる。また、第１態様のレーザ測量装置では、各透明部材のなす角の大きさを変化させることによってのみビーム軸の向きを調整しているので、鏡筒全体の向きを変える必要がない。よって、レベル検知器の測定値は整準作業を通じて常に一定であるので、従来のように、整準作業を行う際にレベル検知器の測定値が安定するまでの時間を要しない。よって、整準作業の時間を短縮することができる。

【００１７】このような構成のレーザ測量装置を用いる際には、前記弾性部材を蛇腹状の形状を有するものとしてもよいし、前記液層を形成する液体をシリコーンオイルとしてもよい。

【００１８】また、上記構成のレーザ測量装置は、前記第１および第２透明部材を透過したレーザビームを９０°偏向する反射部材と、前記反射部材を回転させることによりこの反射部材によって偏向されたレーザビームの出射方向を一定平面内で回転させる回転手段とをさらに備えるものであってもよい。

【００１９】さらに、上記構成のレーザ測量装置は、前記レーザ光源から出射されたレーザビームを２以上のレーザビームに分割するビーム分割手段と、前記ビーム分割手段によって分割されたレーザビームのうちの１つを集光する集光レンズと、前記集光レンズの焦点面上に配置され、前記集光レンズによって集光されたレーザビームの入射位置を検知する光位置検出手段とをさらに備え、前記制御手段は前記第１透明部材と前記第２透明部材のなす角の大きさを前記光位置検出手段に入射した前記レーザビームの入射位置の変化量に基づいて算出するものであってもよい。

【００２０】このような構成のレーザ測量装置を採用すれば、各透明部材のなす角の大きさを、ビーム分割手段により分割されたビームの光位置検出素子への入射位置の変化量に対応させて検出することができる。よって、ビーム軸の向きをより精密に調整することができる。

【００２１】また、本発明のレーザ測量装置の第２の態様は、レーザ光源と、このレーザビームのビーム軸を中心として回転可能に鏡筒内に保持されるとともに前記レーザ光源から出射されたレーザビームを透過する第１楔ガラスと、前記レーザビームのビーム軸を中心として回転可能に鏡筒内に保持されるとともに前記第１楔ガラスを透過したレーザビームを透過する第２楔ガラスと、前記鏡筒内に保持された前記第１および第２楔ガラスを回転させる回転機構と、前記鏡筒の水平面に対する傾斜角を検出するレベル検知器と、前記レベル検知器によって検出された前記傾斜角の大きさに応じて前記回転機構を制御し、前記第１および第２楔ガラスを透過するレーザビームの出射方向を調整する制御手段とを備える。

【００２２】すなわち、第２態様のレーザ測量装置は、レーザビームの光路上に２枚の楔ガラスを配置し、各楔ガラスを当該レーザビームの光路に直交する面内で回転することによりレーザビームのビーム軸の向きを調整することができる。これにより、第１態様と同様、レーザ測量装置の構造を簡素化することができ、しかも整準作業の時間を短縮することができる。

【００２３】このような構成のレーザ測量装置は、前記第１および第２楔ガラスを透過したレーザビームを９０°偏向する反射部材と、前記反射部材を回転させることによりこの反射部材によって偏向されたレーザビームの出射方向を一定平面内で回転させる回転手段とをさらに備えるものであってもよい。

【００２４】また、第２態様のレーザ測量装置は、前記レーザ光源から出射されたレーザビームを２以上のレーザビームに分割するビーム分割手段と、前記ビーム分割

手段によって分割されたレーザビームのうちの１つを集光する集光レンズと、前記集光レンズの焦点面上に配置され、前記集光レンズによって集光されたレーザビームの入射位置を検知する光位置検出手段とをさらに備え、前記制御手段は前記第１および第２楔ガラスの回転を前記光位置検出手段に入射した前記レーザビームの入射位置の変化量に応じて制御するものであってもよい。

【００２５】上記各態様のレーザ測量装置を用いる際には、前記ビーム分割手段は入射光の一部を透過するとともに残りを反射するビームスプリッタであってもよいし、前記光位置検出手段は２次元ポジション・センシティブ・ディテクタ（ＰＳＤ）であってもよい。

【００２６】さらに、上記各態様のレーザ測量装置は、前記ビーム分割手段によって分割されたレーザビームの他の１つを９０°偏向する反射部材と、前記反射部材を回転させることによりこの反射部材によって偏向されたレーザビームの出射方向を一定平面内で回転させる回転手段とをさらに備えるものであってもよい。このとき、前記反射部材はペンタプリズムであってもよい。また、このとき、前記レベル検知器によって検出される傾斜角は前記ビーム分割手段によって分割されて前記反射部材に入射するレーザビームのビーム軸の鉛直に対する傾きに対応していてもよい。

【００２７】

【発明の実施の形態】以下、図面に基づいて、本発明の実施形態を説明する。

<第１実施形態>図１は、本発明の第１実施形態によるレーザ測量装置を構成する投光装置の構成を示す断面図である。この図１は、水平方向へのレーザ光走査を行うためにレーザ測量装置を鉛直方向に立てたときの投光装置の状態を示している。

【００２８】投光装置１１は、レーザ測量装置のハウジング（図示せず）内に固定された鏡筒１４と、ベアリング１９を介して鏡筒１４に回転自在かつ同軸に保持された回転投光部１５とから構成されている。鏡筒１４には、その機械軸l_1（回転投光部１５の回転軸と一致）に沿ったレーザビーム光路１４ｂと、このレーザビーム光路１４ｂに直交するレーザビーム光路１４ａとが、形成されている。また、回転投光部１５には、レーザビーム光路１４ｂに連通するとともにその回転軸と同軸に形成された中空のレーザビーム光路１５ａ，およびこのレーザビーム光路１５ａに連通するとともに端面方向および側方に開口を有するペンタプリズム収納部１５ｂが、形成されている。

【００２９】（レーザ出射光学系）鏡筒１４内のレーザビーム光路１４ａおよび１４ｂの交点には、ビーム分割手段としてのビームスプリッタ２４が固定されている。また、このレーザ光光路１４ａの一方の端部には、レーザダイオード２１が固定されている。また、このレーザダイオード２１とビームスプリッタ２４との間には、レーザダイオード２１側から、コリメータレンズ２２，アナモプリズム２３，およびビーム軸調整部３３が固定されている。また、回転投光部１５のペンタプリズム収容部１５ｂには、ペンタプリズム２７および楔形プリズム３０が固定されている。

【００３０】レーザ光源としてのレーザダイオード２１は、レーザビームL_1を出射する。コリメータレンズ２２は、レーザダイオード２１から出射されたレーザビームL_1を平行光にするレンズである。また、アナモプリズム２３は、コリメータレンズ２２を透過したレーザビームL_1の断面形状を真円形に修正するための光学素子である。

【００３１】アナモプリズム２３を透過したレーザビームL_1は、光軸調整部３３を透過して、ビームスプリッタ２４に入射する（光軸調整部３３については、後に詳述する）。ビームスプリッタ２４内には、レーザビームL_1のビーム軸に対してペンタプリズム２７側に４５°傾いた、部分透過膜２４ａが形成されている。この部分透過膜２４ａは、７０～８０％の反射率を有するため、レーザビームL_1の２０～３０％を透過させるとともに残りのレーザビームを反射する特性を有している。従って、アナモプリズム２３を透過したレーザビームL_1の７０～８０％がペンタプリズム２７側へ反射される。

【００３２】このビームスプリッタ２４を反射したレーザビームL_1は、レーザ光光路１４ｂ内に固定された前群レンズ２５および後群レンズ２６に入射する。これら前群レンズ２５および後群レンズ２６は、入射されたレーザビームL_1のビーム径を拡大するビームエキスパンダを構成する。

【００３３】後群レンズ２６を透過したレーザビームL_1が入射するペンタプリズム２７は、回転投光部１５のペンタプリズム収容部１５ｂ内に、この回転投光部１５と一体に回転するように固定されている。このペンタプリズム２７は、レーザビームL_1が入射する光入射面２７ｃと、この光入射面２７ｃに対して２２．５°傾いているとともにこの光入射面２７ｃから入射したレーザ光が反射する第１反射面２７ａと、この第１反射面２７ａに対して４５°傾いているとともにこの第１反射面２７ａで反射されたレーザビームを再度反射する第２反射面２７ｂと、光入射面２７ｃに対して直角をなしているとともに第２反射面２７ｂで反射されたレーザビームL_1を出射する光出射面２７ｄとを有している。なお、第２反射面２７ｂには、図示せぬ増反射膜がアルミニウム蒸着によって形成されているので、この第２反射面２７ｂにおいてレーザビームは１００％内面反射する。一方、第１反射面２７ａには、反射率が７０～８０％の部分透過膜が形成されている。従って、２０～３０％のレーザビームL_1がこの第１反射面２７ａを透過し、楔形プリズム３０を通って投光装置１２の上端から出射される。

【００３４】ペンタプリズム２７の光出射面２７ｄから

出射されたレーザビームL₁は、ペンタプリズム収容部１５ｂの側方に開口した投光用窓１５ｃ，および図示せぬハウジングの窓を透過して出射される。このようにして出射されたレーザビームL_1は、回転投光部１５ごとペンタプリズム２７がレーザビームL_1に直交する面内で回転することにより、壁面などに垂直または水平方向の基準線を投射する。

【００３５】（回転機構）次に、回転投光部１５を鏡筒１４に対して回転させるための機構（回転手段）を説明する。ベアリング１９を介して鏡筒１４に対して回転自在に接続された回転投光部１５の外周面には、ギア３５が固定されている。一方、鏡筒１４の上端面には、外方に向けて突出させたブラケット３６が設けられている。このブラケット３６には、投光部回転用モータ３７が固定されており、この投光部回転用モータ３７の回転軸に取り付けられたピニオン３８が回転投光部１５のギア３５に噛み合っている。この投光部回転用モータ３７を回転させることにより、投光用窓１５ｃから出射されるレーザ光L_1の出射方向が回転投光部１５の回転軸を中心に回転するので、この回転軸に直交する基準平面が形成される。

【００３６】（整準機構）前述したように、レーザビームL_1によって壁面などに垂直または水平方向の基準線を投射するためには、レーザビームL_1の出射方向が正確に調整されている必要がある。例えば、図１の状態においては、水平方向の基準線を投射するレーザビームL_1が正確に水平に投射されなければならない。以下、このようなレーザビームL_1の出射方向を調整するための整準機構について説明する。

【００３７】図２は、図１のレーザ測量装置１０における整準機構を説明するための、鏡筒１４に固定された各部材の一部を示す図である。また、図３は、ビーム軸調整部３３をビームスプリッタ２４側から見た正面図であり、図４は、図３のＡ－Ａ線に沿った断面図である。ビーム軸調整部３３には、透明部材としての２枚の円形の略平行ガラス４１，４２が互いに略平行となるように設置されており、これら略平行ガラス４１，４２の周縁部分は、環状のガラス押さえ枠４５，４６にはめ込まれている。ガラス押さえ枠４５の、ガラス押さえ枠４６に対向する開口縁には、略平行ガラス４１を保持するための受け座４５ｄが形成されている。同様に、ガラス押さえ枠４６のガラス押さえ枠４５に対向する開口縁には、略平行ガラス４２を保持するための受け座４６ｄが形成されている。

【００３８】カバー４３（弾性部材）は、弾性体からなる蛇腹状の円筒形状を有しており、その両開口縁は、ガラス押さえ枠４５，４６の受け座４５ｄ，４６ｄにそれぞれ接着されることにより、封止されている。そして、カバー４３の内部にはシリコーンオイルなどの液体が充填されることにより、液層４４が形成されている。

【００３９】ガラス押さえ枠４５，４６の外周面上には、矩形板状のピン取付部４５ａ，４６ａが、各ガラス押さえ枠４５，４６と一体に形成されている。ピン４７は、その両端部が他の部分よりも細く形成されており、ピン取付部４５ａ，４６ａを貫通するように取り付けられている。このため、各ピン取付部４５ａ，４６ａが形成された部分における各ガラス押さえ枠４５，４６間の距離は、ほぼ一定に保たれている。但し、各ピン取付部４５ａ，４６ａは、ピン４７に対してこのピン４７の軸方向に若干の範囲で移動可能となっている。

【００４０】また、ガラス押さえ枠４５の外周面上には、矩形板状の２つのリードネジ保持部４５ｂ，４５ｃがこのガラス押さえ枠４５と一体に形成されている。これらリードネジ保持部４５ｂ，４５ｃおよびピン取付部４５ａは、ガラス押さえ枠４５の外周面の３等分位置から外方に突出するように、形成されている。そして、ガラス押さえ枠４６のリードネジ保持部４５ｂに重なる外周面上には、リードネジ保持部４６ｂが形成されている。リードネジ保持部４６ｂには、ネジ孔４６ｅが形成されており、このネジ孔４６ｅには、リードネジ４８がねじ込まれている。

【００４１】リードネジ４８は、他の部分よりも細く形成され、かつ、雄ねじが切られていない端部４８ａを有しており、この端部４８ａがリードネジ保持部４５ｂに回転自在に挿通されている。リードネジ保持部４５ｂを貫通した端部４８ａには、ストッパリング５５が嵌合されているため、リードネジ４８は、リードネジ保持部４５ｂから落脱しないように保持されている。そして、リードネジ４８は、その先端に固定されたリードネジギア５３，このリードネジギア５３に噛合するモータギア５２を介して、リードネジ保持部４５ｂに固定されたモータ５１によって回転される。このモータ５１は、制御部３５によって駆動制御されている。このモータ５１によるリードネジ４８の回転に伴い、リードネジ保持部４６ｂがリードネジ４８の軸方向（図４のＢ方向）に沿って移動される。このため、リードネジ保持部４５ｂ，４６ｂが形成された部分における各略平行ガラス４２，４３間の距離は変化される。また、リードネジ保持部４５ｃ，４６ｃについても、リードネジ保持部４５ｂ，４６ｂと同様の機構が設けられている。このため、リードネジ保持部４５ｃが形成された部分における各略平行ガラス４２，４３間の距離も、制御部３５によって変化される。

【００４２】図５に、モータ５１が回転されたときの光軸調整部３３の様子を示す。上述したように、モータ５１が回転されることによりリードネジ４８が回転し、これに伴い、リードネジ保持部４６ｂがこのリードネジ４８の軸に沿って移動する。このため、図５に示すように、この部分における各略平行ガラス４１，４２間の距離は小さくなる。一方、各ピン取付部４５ａ，４６ａが

形成された部分における各略平行ガラス４１，４２間の距離は、ピン４７によって一定に保たれている。従って、各略平行ガラス４１，４２は平行より若干の角度を持って対向する状態となる。このとき、各略平行ガラス４１，４２のなす角（すなわち液層４４の頂角）を$\theta°$とし、液層４４の屈折率をｎ（但し、ｎ≒１．５）とする。そして、略平行ガラス４２に入射し、液層４４を透過して略平行ガラス４１から出射されるレーザビームＬ$_1$のビーム軸の偏角を$\theta'°$とすると、次式の関係が成り立つ。

$\theta' = (n-1)\theta$　・・・（１）

すなわち、液層４４の頂角θの大きさを制御することにより、このビーム軸調整部３３を透過するレーザビームＬ$_1$のビーム軸の向きを変化させることができる。

【００４３】また、図１および図２に示すように、鏡筒１４のレーザ光光路１４ａのレーザダイオード２１に対向する端面には、光位置検出手段としての２次元ポジション・センシティブ・ディテクタ（以下、「ＰＳＤ」という）２９が、その受光面をビームスプリッタ２４側に向けて固定されている。また、レーザ光光路１４ａ内の２次元ＰＳＤ２９とビームスプリッタ２４との間には、集光レンズ２８が固定されている。この集光レンズ２８と２次元ＰＳＤ２９との間の距離は、集光レンズ２８の焦点距離ｆ$_1$に等しい。よって、レーザダイオード２１から出射され、ビームスプリッタ２４に入射したレーザビームＬ$_1$のうち、部分透過膜２４ａを透過した２０～３０％のレーザビームＬ$_1$は、集光レンズ２８を透過して２次元ＰＳＤ２９上に集光される。２次元ＰＳＤ２９は、光の入射位置を検出する機器である。２次元ＰＳＤへのレーザビームＬ$_1$の入射位置は、この２次元ＰＳＤ２９の各出力端子から出力される電流比に基づいて算出される。なお、この２次元ＰＳＤの各出力端子は制御部３５に接続されている。

【００４４】また、鏡筒１４のレーザ光光路１４ｂの下端部には、ｘ方向（紙面内での回転方向）の水平からの傾きを検出するチルトセンサ３１（レベル検知器）が固定されている。そして、チルトセンサ３１の側方には、ｙ方向（鉛直方向に沿って紙面に直交する面内での回転方向）の水平からの傾きを検出するチルトセンサ３２が固定されている。チルトセンサ３１，３２は電解液が満たされた気泡管内の気泡の位置変化を抵抗値変化としてとらえて電気信号に変換することにより水平からの傾きを検出するものである。すなわち、チルトセンサ３１，３２の上面には、それぞれ、２個の電極（図示せず）が傾斜角の検出方向に対象な位置関係で設けられているとともに、その下面全域には共通の電極が設けられている。従って、各チルトセンサ３１，３２内で気泡の位置が変化するとこれら上面上の各電極と共通電極との間の抵抗値の比が変化する。各チルトセンサ３１，３２はこれら各電極を介して制御部３５に接続されており、各電極に生じる抵抗値同士の比の変化に基づいて、鏡筒１４の傾きの変化量が算出される。

【００４５】図２の状態では、図示せぬ測定装置が用いられることにより、レーザビームＬ$_1$が正確に水平に出射され、レーザビームＬ$_1$が鉛直方向１$_0$に出射されるように、鏡筒１４の向きが調整されているものとする。なお、このとき、レーザビームＬ$_1$のビーム軸と鏡筒１４の機械軸１$_1$とは、完全に一致しているものとする。このときのチルトセンサ３１，３２の測定値，およびレーザビームＬ$_1$の２次元ＰＳＤ２９への入射位置は、初期値として制御部へ記憶される。このときの、レーザビームＬ$_1$の２次元ＰＳＤ２９への入射位置のＰＳＤ中心座標ａ$_0$からのｘ方向における距離をａ$_1$とする。ここで、鏡筒機械軸１$_1$と鉛直方向１$_0$とは完全に一致した状態であるので、各チルトセンサ３１，３２による測定値は、鏡筒１４の機械軸１$_1$が鉛直であるときの値を示すが、鏡筒機械軸１$_1$とレーザビームＬ$_1$のビーム軸との位置関係によっては、この測定値が必ずしも鉛直時の値を示す必要はない。

【００４６】図６は、図２の状態からペンタプリズム２７の光出射面２７ｄから出射されたレーザビームＬ$_1$のビーム軸が水平からｘ方向に＋$\Delta\omega°$傾いたとき、すなわちレーザビームＬ$_1$のビーム軸が鉛直から＋$\Delta\omega°$傾いた状態を示している（図６のｘ方向において、時計方向の向きを＋としている）。このとき、鏡筒１４の機械軸１$_1$も同様に図２の状態から鉛直方向１$_0$に対して＋$\Delta\omega°$傾いた状態となっているため、チルトセンサ３１の測定値も初期値から＋$\Delta\omega°$の傾き相当変化する。

【００４７】すると、制御部３５によりチルトセンサ３１の測定値が読み込まれる。制御部３５は、チルトセンサ３１の測定値に基づいてレーザビームＬ$_1$のビーム軸の傾斜量＋$\Delta\omega°$を算出する。それに応じて、ビーム軸調整部３３の各リードネジ保持部４５ｂ，４５ｃのモータ５１，５１が回転され、モータギア５２，５２およびリードネジギア５３，５３を介して連通されたリードネジ４８，４８がそれぞれ回転されるため、リードネジ保持部４６ｂ，４６ｃがリードネジ４８，４８の軸方向に移動される。これにより、液層４４が形成する頂角θの大きさが変化されるため、レーザビームＬ$_1$のビーム軸の出射方向が調整される。図７に、液層４４の頂角θの大きさが変化されることによって、レーザビームＬ$_1$のビーム軸が鉛直方向１$_0$になるように調整された様子を示す。レーザビームＬ$_1$が鉛直方向１$_0$に出射されるよう調整するためには、ビーム軸調整部３３から出射されるレーザビームＬ$_1$のビーム軸を、コリメータレンズ２２の光軸に対して＋$\Delta\omega°$だけ傾斜させる必要がある。レーザビームＬ$_1$のビーム軸が、コリメータレンズ２２の光軸に対して＋$\Delta\omega°$傾斜されたとき、ｘ方向におけるレーザビームＬ$_1$の２次元ＰＳＤ２９への入射位置の初期値ａ$_1$からのズレ量ｂは、ｂ＝ｆ$_1$ｔａｎ（＋$\Delta\omega°$）

となる。従って、制御部３３は、２次元ＰＳＤ２９から出力されたレーザビームL_1の入射位置を常にモニタしながら各モータ５１，５１を駆動制御し、２次元ＰＳＤ２９に入射するレーザビームL_1の入射位置の中心座標a_0からのｘ方向のズレが$a_1+b=a_1+f_1\tan(+\Delta\omega°)$となるように、ビーム軸調整部３３の液層４４の頂角θを変化させるのである。このときの液層４４の頂角θは、（１）式より、

$$\theta=\theta'/(n-1)$$
$$=\Delta\omega/(n-1)$$
（但し、ｎは液層４４の屈折率）

となるように変化される。これにより、レーザビームL_1のビーム軸は、図６の状態から$-\Delta\omega°$だけ傾斜されて鉛直方向l_0と一致する。従って、回転投光部１５から出射されるレーザビームL_1のビーム軸が水平になるよう調整される。

【００４８】なお、ここでは、チルトセンサ３１によって検出される、レーザビームL_1のビーム軸の傾きのｘ方向の調整のみについて説明したが、チルトセンサ３２によって検出されるｙ方向のビーム軸の調整も、同様にして行われる。

【００４９】すなわち、本実施形態のレーザ測量装置では、レーザビームL_1によって形成される基準平面の水平からの傾きに応じてビーム軸調整部３３の液層４４の頂角θの大きさを調整することによりレーザビームL_1の出射方向を調整している。また、ビーム軸調整部３３を駆動させたときの各ビーム軸の向きの変化を、コリメータレンズ２２の光軸上に設置した２次元ＰＳＤ２９へのレーザビームL_1の入射位置によって監視している。このため、ビーム軸調整部３３によるビーム軸L_1の向きの僅かな変化量を高精度に調整することができる。

【００５０】このように、本実施形態のレーザ測量装置は、液層４４を封止した２枚の略平行ガラス４１，４２の相対角度を変化させることにより整準を行っているので、従来のように鏡筒全体を傾けるための複雑な構造を必要としない。このため、レーザ測量装置の構造を簡単にすることができる。また、本実施形態のレーザ測量装置は、整準の際に投光装置１１をハウジングに対して傾ける必要がないため、整準作業の途中でチルトセンサ３１，３２の測定値が変化することもない。よって、従来のように、チルトセンサの測定値を安定させるための時間を必要としないので、整準作業を短時間に行うことができる。

【００５１】＜第２実施形態＞図８に本発明の第２実施形態におけるレーザ測量装置の整準機構およびレーザ出射光学系の一部を示す。本第２実施形態は、鉛直方向にレーザ走査するために、鏡筒１４を図１の状態に対して９０°傾けて用いる場合に適用される。

【００５２】ｘ方向（紙面内での回転方向）のチルトセンサ６１は、レーザビームL_1のビーム軸方向が水平方向l_0'となるように、図１の状態に対してｘ方向に９０°傾けられた状態で固定されている。そして、第１実施形態と同様、ｘ方向のチルトセンサ６１は、ビーム軸調整部３３や２次元ＰＳＤ２９とともに制御部５３に接続されている。

【００５３】以下、本実施形態のレーザ測量装置の整準機構の動作を説明する。まず、制御部５３は、図８のように、レーザ光L_1のビーム軸が水平方向l_0'となるように調整されているときの、チルトセンサ６１の測定値と２次元ＰＳＤ２９へのレーザビームL_1の入射位置を記憶する。なお、このとき、レーザビームL_1のビーム軸と鏡筒１４の機械軸l_1'とは完全に一致しているものとする。このとき、レーザビームL_1の２次元ＰＳＤ２９への入射位置のＰＳＤ中心a_0からのｘ方向における距離をa_1とする。そして、図９に示すように、レーザビームL_1のビーム軸が水平方向l_0'からｘ方向に$+\Delta\omega°$ずれた場合には、制御部５３は、２次元ＰＳＤ２９へのレーザビームL_1のｘ方向の入射位置のＰＳＤ中心a_0からの距離が$a_1+f_1\tan(+\Delta\omega)$となるように、ビーム軸調整部３３の略平行ガラス４１に対する略平行ガラス４２の角度を変化させて、レーザビームL_1のビーム軸の方向を調整する。このようにして、レーザビームL_1のビーム軸を図９の状態より$-\Delta\omega°$回転させて、水平方向l_0'を向かせるように調節することができる（図１０参照）。

【００５４】このように、本実施形態では、鉛直方向のレーザ走査を行うために、レーザ測量装置を水平方向に向けて使用する場合でも、第１実施形態と同様に液層４４を封止した２枚の略平行ガラス４１，４２の相対角度を変化させることによりレーザビームL_1のビーム軸の方向が調整されるビーム軸調整部３３を用いて整準作業を行っている。これにより、レーザビームL_1のビーム軸の向きを鏡筒機械軸l_1'に対して傾斜させて、レーザビームL_1のビーム軸が水平になるように調整することができる。

【００５５】＜第３実施形態＞図１１は、本発明の第３実施形態のレーザ測量装置におけるビーム軸調整部６３の構造を示す断面図である。本第３実施形態のレーザ測量装置は、２枚の楔ガラスをコリメータレンズ２２の光軸を中心としてそれぞれ回転させることによりレーザ光L_1のビーム軸の向きを調整することにより整準作業を行うことを特徴とし、その他の部分を第１および第２実施形態と同一とする。

【００５６】鏡筒１４のレーザ光光路１４ａ内に固定されたビーム軸調整部６３は、透明部材からなる箱形のケーシング６６と、このケーシング６６内に保持された２枚の楔ガラス６４，６５とから構成される。楔ガラス６４，６５は、平行より僅かに角度を持って相対した平面からなる光学素子であり、それらの入射面をレーザダイオード２１側に向けるように並べて配置されている。これら各楔ガラス６４，６５は、コリメータレンズ２２の

光軸に垂直な面内で回転自在な状態でケーシング６６内に保持されている。また、各楔ガラスの６４，６５の回転軸は、コリメータレンズ２２の光軸と一致するように、構成されている。これら各楔ガラス６４，６５の外周部分には、ギア６７，６８がそれぞれ嵌合されており、各ギア６７，６８はケーシング６６内に固定されたモータ６９，７０によって回転される。これら各モータ６９，７０は制御部３５に接続されており、この制御部３５によって各楔ガラス６４，６５の回転制御がなされている。なお、本実施形態では、各ギア６７，６８および各モータ６９，７０とを併せて、「回転機構」としている。

【００５７】このビーム軸調整部６３にレーザ光L_1が入射されると、２枚の楔ガラス６４，６５を透過することによりこのレーザ光L_1のビーム軸が屈曲される。そして、制御部３５によって各楔ガラス６４，６５が回転されると、ビーム軸調整部６３を透過するレーザビームL_1のビーム軸の向きが変化される。このようにして、レーザビームL_1のビーム軸の向きを調整することにより、レーザビームL_1のビーム軸が鉛直方向1_0に出射されるよう調整することができる。

【００５８】以下、図２，６，７，および１１を用いて、上記構成のビーム軸調整部６３を用いた本実施形態のレーザ測量装置の整準方法を説明する。前述したように、鏡筒１４の向きは、図示せぬ測定装置により、レーザビームL_1が正確に水平に出射され、レーザビームL_1が鉛直方向1_0に出射されるように、調整されている（このとき、レーザ光L_1のビーム軸と鏡筒１４の機械軸1_1は完全に一致している）。このときのチルトセンサ３１，３２の測定値，およびレーザビームL_1の２次元ＰＳＤ２９への入射位置は、制御部３５に記憶される。第１実施形態と同様に、このときのレーザビームL_1の２次元ＰＳＤ２９への入射位置のＰＳＤ中心a_0からの距離をa_1とする。そして、図６に示すように、レーザビームL_1のビーム軸が鉛直方向1_0に対して$+\Delta\omega°$ずれた場合には、制御部３５は、２次元ＰＳＤ２９へのレーザビームL_1のｘ方向の入射位置のＰＳＤ中心a_0からの距離が$a_1 + f_1 \tan(+\Delta\omega°)$となるように各モータ６９，７０の回転制御を行い、各楔ガラス６４，６５をコリメータレンズ２２の光軸に直交する面内で回転させることにより、ビームスプリッタ２４に入射されるレーザビームL_1のビーム軸の向きを調整する。このようにして、レーザビームL_1のビーム軸を図６の状態より$-\Delta\omega°$回転させて、鉛直方向1_0を向かせるように調整することができる（図７）。

【００５９】なお、ここでは、水平方向のレーザ走査を行うために、図１のようにレーザ測量装置を鉛直に立てて用いた場合の整準機構について説明したが、鉛直方向へのレーザ走査を行う際にも、第２実施形態と同様にチルトセンサ３１を図１の状態から９０°回転された状態で固定することにより、同様の整準作業を行うことができる。

【００６０】

【発明の効果】本発明によれば、複雑な整準機構を必要とせず、レーザ測量装置の構造を簡素化することができる。また、整準作業を短時間で行うことができるレーザ測量装置を提供することができる。

【図面の簡単な説明】

【図１】　本発明の第１実施形態によるレーザ測量装置の構造を示す断面図

【図２】　本発明の第１実施形態によるレーザ測量装置の整準機構を説明するための図

【図３】　本発明の第１実施形態によるレーザ測量装置におけるビーム軸調整部３３の正面図

【図４】　図３のＡ－Ａ線に沿った断面図

【図５】　モータ５１を回転させたときのビーム軸調整部３３の状態を示す断面図

【図６】　図２の状態からレーザビームL_1のビーム軸が$+\Delta\omega°$傾いた様子を示す図

【図７】　図６の状態から整準作業が行われた様子を示す図

【図８】　本発明の第２実施形態によるレーザ測量装置の整準機構を説明するための図

【図９】　図８の状態からレーザビームL_1のビーム軸が$+\Delta\omega°$傾いた様子を示す図

【図１０】　図９の状態から整準作業が行われた様子を示す図

【図１１】　本発明の第３実施形態のレーザ測量装置におけるビーム軸調整部６３の構造を示す断面図

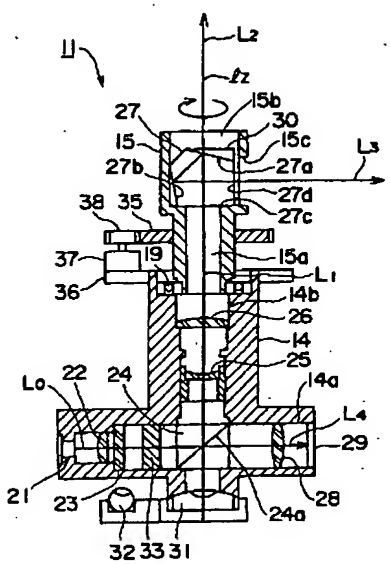
【図１２】　従来技術のレーザ測量装置の構造を示す断面図

【符号の説明】

２１　レーザダイオード
２２　コリメータレンズ
２４　ビームスプリッタ
２７　ペンタプリズム
２８　集光レンズ
２９　２次元ＰＳＤ
３１，３２，６１，６２　チルトセンサ
３３，６３　ビーム軸調整部
３５，５３　制御部
４１，４２　略平行ガラス
４３　カバー
４４　液層
４５，４６　ガラス押さえ枠
４５ｂ，４６ｂ　リードネジ保持部
４７　ピン
４８　リードネジ
５１　モータ
５２　モータギア

53　リードネジギア
64，65　楔ガラス
L_1，L_2，L_3，L_4　レーザビーム
θ　頂角

【図1】



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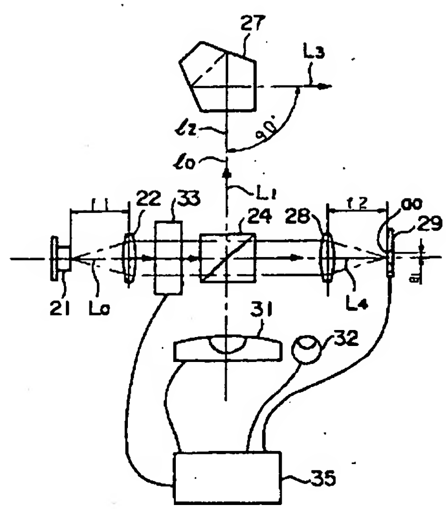

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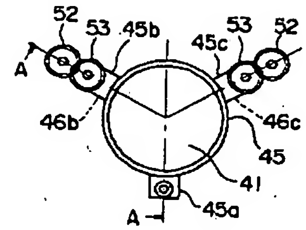

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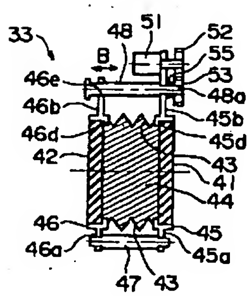

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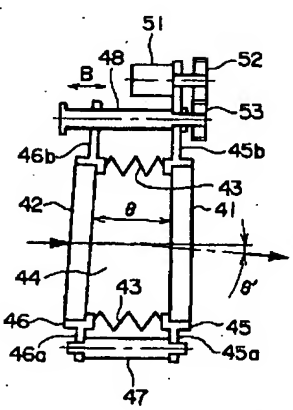

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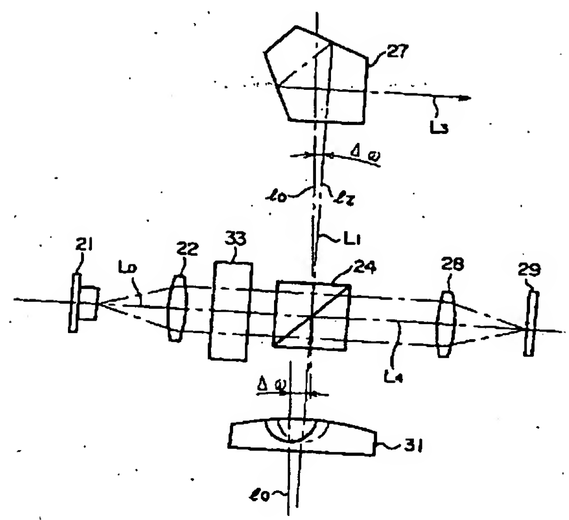

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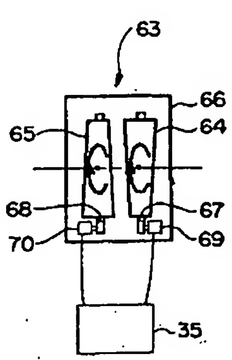
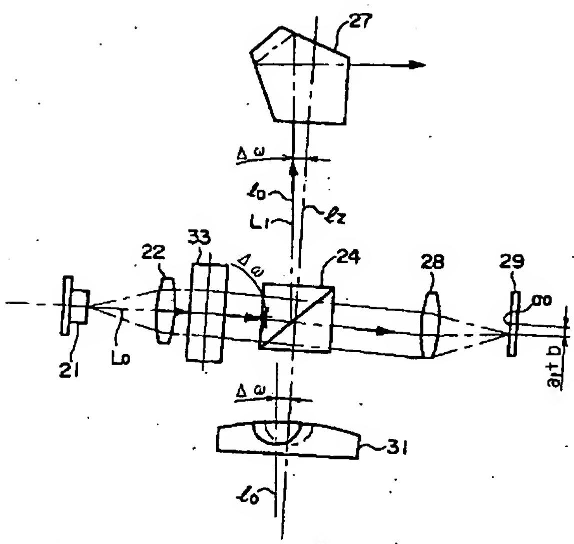
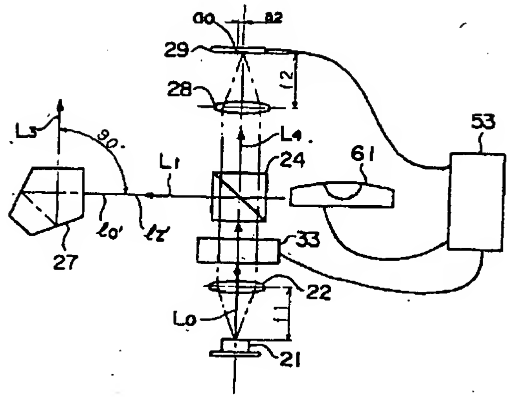


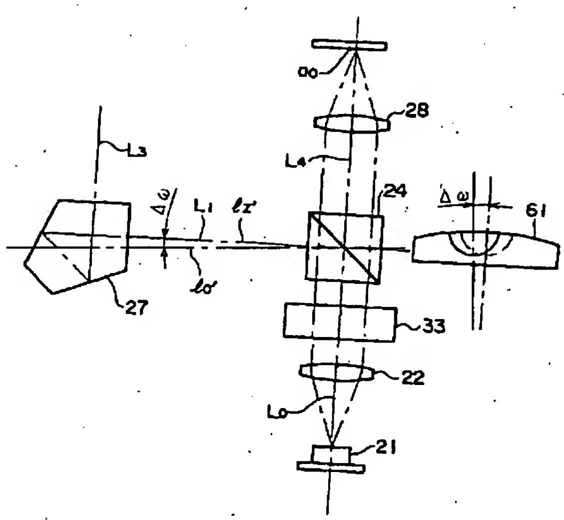
【図７】


27
Δω
ℓ0
L1
ℓz
22
33
Δω
24
28
29
a0
21
L0
a1+b
Δω
31
ℓ0

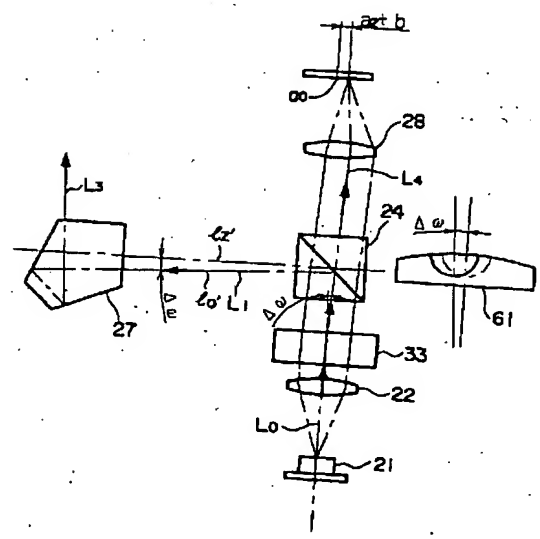
【図８】


a0
a2
29
28
f2
L3
90°
L4
53
L1
24
61
ℓ0'
ℓz'
27
33
22
L0
f1
21

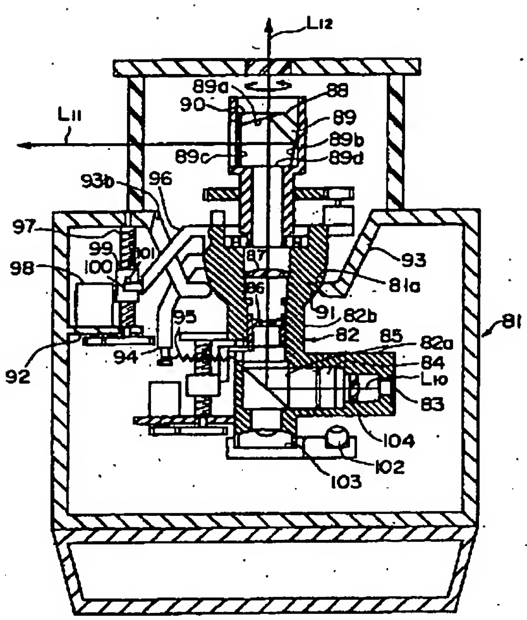
【図９】


a0
28
L3
L4
24
Δω
61
Δω
L1
ℓz'
27
ℓ0'
33
22
L0
21

【図１０】


a2+b
a0
28
L3
L4
24
Δω
ℓz'
27
Δω
ℓ0'
L1
Δω
61
33
22
L0
21

【図１２】


L12
89a
88
90
89
L11
89b
89c
89d
93b
96
97
99
101
87
93
100
98
86
81a
91
82b
95
82
85
81
82a
94
84
92
L10
83
104
102
103

PATENT ABSTRACTS OF JAPAN

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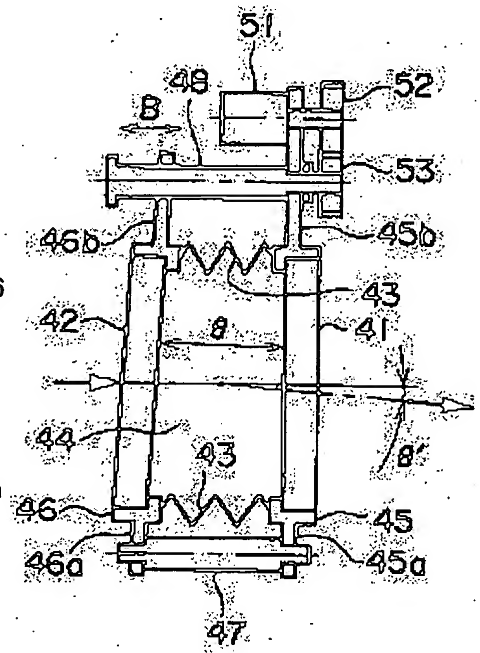
(71)Applicant : ASAHI OPTICAL CO LTD
(72)Inventor : ITO EIICHI

(54) LASER MEASURING INSTRUMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide the laser measuring instrument which can simplify a structure for leveling and completes leveling operation in a short time.

SOLUTION: A bellows type cover 43 made of an elastic body is sealed with two nearly parallel glasses 41 and 42 and the cover 43 is filled with a liquid layer 44. A lead screw hold part 46b formed on a glass pressure frame 46 holding the nearly parallel glass 42 threadably engages a lead screw 48. A motor 51 is rotated to rotate the lead screw 48 and then the lead screw hold part 46b is moved forward and backward in a direction B. Consequently, the vertical angle ? of the liquid layer 44 varies and the direction of the beam axis of a laser beam transmitted through the two nearly parallel glasses 41 and 42 is refracted according to the vertical angle ?.



LEGAL STATUS

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[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] Laser survey equipment characterized by providing the following Laser light source the [which has been arranged on the optical path of the laser beam by which outgoing radiation was carried out from the aforementioned laser light source / abbreviation plate-like / the 1st and] -- 2 transparent member the [the above 1st and] -- the tubed elastic member by which the double door peristome was closed by 2 transparent member the [the solution layer formed by filling up with a liquid in the aforementioned elastic member, and / the above 1st and] -- with the lens-barrel holding 2 transparent member The adjustment mechanism the above 1st held at this lens-barrel and whose adjustment in the range which includes parallel for the relative tilt angle of a member the 2nd transparence are enabled, Control means which adjust the size of the angle which controls the aforementioned adjustment mechanism according to the size of the aforementioned tilt angle detected in the level detector which detects the tilt angle to the level surface of the aforementioned lens-barrel, and the aforementioned level detector, and the aforementioned 1st area-pellucida material and the aforementioned 2nd area-pellucida material make
[Claim 2] The aforementioned elastic member is laser survey equipment according to claim 1 which has the bellows-like configuration.
[Claim 3] The liquid which forms the aforementioned solution layer is laser survey equipment according to claim 1 which is a silicone oil. [Claim 4] the [the above 1st and] -- the laser survey equipment according to claim 1 to 3 further equipped with the reflective member which deflects 90 degrees of laser beams which penetrated 2 transparent member, and a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member by rotating the aforementioned reflective member within a fixed flat surface
[Claim 5] A beam division means to divide into two or more laser beams the laser beam by which outgoing radiation was carried out from the aforementioned laser light source, The condenser lens which condenses one of the laser beams divided by the aforementioned beam division means, It is arranged on the focal plane of the aforementioned condenser lens, and has further an optical position detection means to detect the incidence position of the laser beam condensed with the aforementioned condenser lens. the aforementioned control means -- the [aforementioned] -- the [1 transparent member and / aforementioned] -- the laser survey equipment according to claim 1 to 3 which computes the size of the angle which 2 transparent member makes based on the variation of the incidence position of the aforementioned laser beam which carried out incidence to the aforementioned optical position detection means
[Claim 6] Laser survey equipment characterized by providing the following Laser light source The 1st wedge glass which penetrates the laser beam by which outgoing radiation was carried out from the aforementioned laser light source while being held in the lens-barrel possible [rotation] centering on the beam shaft of this laser beam The 2nd wedge glass which penetrates the laser beam which penetrated the aforementioned 1st wedge glass while being held in the lens-barrel possible [rotation] centering on the beam shaft of the aforementioned laser beam the [the above 1st held at the aforementioned lens-barrel, and] -- the size of the aforementioned tilt angle detected in the rolling mechanism which rotates 2 wedge glass, the

level detector which detects the tilt angle to the level surface of the aforementioned lens-barrel, and the aforementioned level detector -- responding -- the aforementioned rolling mechanism -- controlling -- the [the above 1st and] -- the control means which adjust the direction of outgoing radiation of the laser beam which penetrates 2 wedge glass
[Claim 7] the [the above 1st and] -- the laser survey equipment according to claim 6 further equipped with the reflective member which deflects 90 degrees of laser beams which penetrated 2 wedge glass, and a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member by rotating the aforementioned reflective member within a fixed flat surface
[Claim 8] A beam division means to divide into two or more laser beams the laser beam by which outgoing radiation was carried out from the aforementioned laser light source, The condenser lens which condenses one of the laser beams divided by the aforementioned beam division means, It is arranged on the focal plane of the aforementioned condenser lens, and has further an optical position detection means to detect the incidence position of the laser beam condensed with the aforementioned condenser lens. the aforementioned control means -- the [the above 1st and] -- the laser survey equipment according to claim 6 which controls rotation of 2 wedge glass according to the variation of the incidence position of the aforementioned laser beam which carried out incidence to the aforementioned optical position detection means
[Claim 9] The aforementioned beam division means is laser survey equipment according to claim 5 or 8 which is the beam splitter which reflects the remainder while penetrating a part of incident light.
[Claim 10] The aforementioned optical position detection means is laser survey equipment according to claim 5 or 8 which is a two-dimensional position sensitive detector (PSD).
[Claim 11] Laser survey equipment according to claim 5 or 8 further equipped with the reflective member which deflects other one [90-degree] of the laser beams divided by the aforementioned beam division means, and a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member by rotating the aforementioned reflective member within a fixed flat surface.
[Claim 12] The aforementioned reflective member is laser survey equipment given in either of the claims 4, 7, and 11 which are pentaprisms.
[Claim 13] The tilt angle detected in the aforementioned level detector is laser survey equipment given in either of the claims 4, 7, 11, and 12 corresponding to the inclination to the vertical of the beam shaft of the laser beam which it is divided by the aforementioned beam division means, and carries out incidence to the aforementioned reflective member.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates the datum line by the laser beam to horizontal or the laser survey equipment projected perpendicularly to a predetermined field.
[0002]
[Description of the Prior Art] Conventionally, in fields, such as engineering works and construction, the laser survey equipment (the so-called laser planar) for performing marking of a horizontal line or a vertical line is used. This laser equipment rotates the floodlighting section which carries out outgoing radiation of the laser beam, scans this laser beam to a hoop direction, and projects the datum line perpendicular to planes of incidence-ed, such as a wall surface, or horizontal by tracing of a laser beam.
[0003] Drawing 12 is the cross section showing the composition of conventional laser survey equipment. This drawing 12 shows the state where laser survey equipment was stood in the perpendicular direction, in order to perform the laser beam scan to a horizontal direction. The lens-barrel 82 dedicated in housing 81 consists of laser beam optical-path 82a of the hollow which branched at the right angle from laser beam optical-path 82b of the hollow which penetrates the whole along with the medial axis of laser survey equipment, and this laser beam optical-path 82b. In laser beam optical-path 82a, a laser diode 83, the collimator lens unit 104, and the ANAMO prism 84 are being fixed from the end-face side. And the rectangular prism 85 is being fixed to the intersection of the laser beam optical paths 82a and 82b.
[0004] In laser beam optical-path 82b, the pre-group lens 86 and the back group lens 87 are being fixed toward the upper part in drawing 12 from the rectangular prism 85. The approximate circle tubed rotation floodlighting section 88 to which the pentaprism 89 was dedicated is being fixed to the upper-limit section of a lens-barrel 82 free [rotation] in the field which intersects perpendicularly with laser beam optical-path 82b. Opening is formed in the upper-limit side and the side of this rotation floodlighting section 88, respectively.
[0005] In the laser survey equipment of such composition, if outgoing radiation of the laser beam L10 is carried out from the laser diode 83 fixed to the laser beam optical-path 82a end face, in a rectangular prism 85, 90 degrees of the laser beam L10 will be crooked in the rotation floodlighting section 88 side, it will penetrate the pre-group lens 86 and the back group lens 87, and they will carry out incidence to a pentaprism 89. The laser beam L10 which carried out incidence to the pentaprism 89 is gradually reflected by 2nd reflector 89b which inclined 45 degrees to 1st reflector 89a and this 1st reflector. And outgoing radiation of the laser beam L11 which reflector [1st] 89a Reached and was reflected by 2nd reflector 89b is carried out from optical outgoing radiation side 89c which is making the right angle to 89d of optical plane of incidence.
[0006] Moreover, the partial reflection film is formed in 1st reflector 89a. Therefore, some laser beams L12 penetrate this 1st reflector 89a, penetrate the wedge prism 90 fixed on this 1st reflector 89a, and outgoing radiation is carried out from opening of a rotation floodlighting section 88 upper-limit side.
[0007] And a laser beam L11 rotates focusing on the axis of rotation of the rotation floodlighting section 88 by rotating in the field where laser beam optical-path 82b and the rotation floodlighting section 88 cross at right angles. Therefore, the base plane which intersects perpendicularly with this

axis of rotation is formed of a laser beam L11. Moreover, the laser beam L12 by which outgoing radiation is carried out from the upper limit of the rotation floodlighting section 88 forms the criteria spot for a survey control point etc. being shown in a ceiling etc.

[0008] Thus, in order to form a base plane in a wall surface etc., outgoing radiation of the laser beam L11 by which outgoing radiation was carried out from laser survey equipment needs to be carried out horizontally correctly. Similarly, outgoing radiation also of the laser beam L12 which forms a criteria spot needs to be correctly carried out to a ceiling etc. perpendicularly. Therefore, at the time of use of laser survey equipment, it is necessary to do leveling-up work so that outgoing radiation of the laser beam L11 may be carried out horizontally correctly.

[0009] Hereafter, the leveling-up mechanism for outgoing radiation of the laser beam L11 being carried out horizontally correctly is explained. sliding which the bulge section 91 which has a semi-sphere side configuration is formed in the upper-limit side of a lens-barrel 82, and was formed in housing 81 -- a hole -- it is held in the state where it contacted in 81a since the maintenance to the housing 81 of a lens-barrel 82 is made by only contact of this portion -- sliding -- a hole -- the lens-barrel 82 whole can be made to tilt in all the directions by rotating the semi-sphere side portion of the bulge section 91 within 81a

[0010] Moreover, in housing 81, the screw 97 rotated by the motor 98 for level adjustment is formed. The nut 99 is screwed in this screw 97. This nut 99 moves up and down with rotation of a screw 97. The operation pin 101 is projected and formed in the superficies of a nut 99. The drive arm 96 formed in the bulge section 91 and the pin 100 open for free passage touch the operation pin 101, and, thereby, rotation of the direction of X of the bulge section 91 (hand of cut within space) is regulated.

[0011] Furthermore, under the rectangular prism 85, the tilt sensor 103 of the direction of X which detects the inclination of the direction of X of a lens-barrel 82 is being fixed in the lens-barrel 82. According to the inclination detected by this tilt sensor 103, the roll control of the motor 98 for level adjustment is performed, and a screw 97 rotates by this. Then, a nut 99 moves up and down with rotation of this screw 97, and the bulge section 91 linked through the operation pin 101 and the pin 100 rotates in the direction of X. In addition, the tilt sensor 102 of the direction of Y which detects the inclination of the direction (hand of cut in the field which intersects perpendicularly with space along the perpendicular-among drawing direction) of Y is being fixed to the side of the tilt sensor of the direction of X. Moreover, although not shown in the drawing, in housing 81, the mechanism for regulating rotation of the direction of Y of the bulge section 91 as well as the direction of X is established according to the size of the inclination detected by the tilt sensor 102. Thus, it is adjusted so that a lens-barrel 82 may always turn to the perpendicular direction, namely, so that outgoing radiation of the laser beam L11 may always be carried out horizontally. Therefore, a laser beam L11 can form always exact datum level.

[0012]

[Problem(s) to be Solved by the Invention] However, with the structure of conventional laser survey equipment which was mentioned above, the leveling-up work for carrying out outgoing radiation of the laser beam L11 horizontally is done by leaning a lens-barrel 82 using the motor 98 for level adjustment, a screw 97, and nut 99 grade. For this reason, there was a problem that the structure of laser survey equipment will become complicated.

[0013] Moreover, if an inclination changes, the tilt sensor 102,103 will require fixed time until the measured value is stabilized possible [measurement]. For this reason, you have to wait to stabilize the measured value of the tilt sensor 102,103, whenever the inclination of a lens-barrel 82 changes, when adjustment by leaning a lens-barrel 82 like before is performed. For this reason, the long time was required in order to do leveling-up work.

[0014] Then, structure for a leveling up can be simplified and let it be the technical problem of this invention to offer the laser survey equipment which can moreover do leveling-up work in a short time.

[0015]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the 1st mode of the laser survey equipment of this invention the [which has been arranged on the optical path of the laser beam by which outgoing radiation was carried out from the laser light source and

the aforementioned laser light source / abbreviation plate-like / the 1st and] -- with 2 transparent member the [the above 1st and] -- with the tubed elastic member by which the double door peristome was closed by 2 transparent member the [the solution layer formed by filling up with a liquid in the aforementioned elastic member, and / the above 1st and] -- with the lens-barrel holding 2 transparent member The adjustment mechanism the above 1st held at this lens-barrel and whose adjustment in the range which includes parallel for the relative tilt angle of a member the 2nd transparence are enabled, The aforementioned adjustment mechanism is controlled according to the size of the aforementioned tilt angle detected in the level detector which detects the tilt angle to the level surface of the aforementioned lens-barrel, and the aforementioned level detector, and it has the control means which adjust the size of the angle which the aforementioned 1st area-pellucida material and the aforementioned 2nd area-pellucida material make.

[0016] That is, the unit which closed the elastic member by the 1st and 2nd transparent members, and filled up the liquid with the laser survey equipment of the 1st mode into it is arranged on the optical path of a laser beam. And the sense of the beam shaft which penetrates each [these] transparent member is changed by changing the angle which each transparent member makes according to the size of the inclination of the level shell of the lens-barrel detected in the level detector. Therefore, since it is not necessary to establish like before the complicated leveling-up mechanism in which a lens-barrel is leaned, the structure of laser survey equipment can be simplified. Moreover, with the laser survey equipment of the 1st mode, since it is accepted by changing the size of the angle which each transparent member makes and the sense of a beam shaft is adjusted, it is not necessary to change the sense of the whole lens-barrel. Therefore, since the measured value of a level detector is always fixed, in case it does leveling-up work like before through leveling-up work, it does not require time until the measured value of a level detector is stabilized. Therefore, the time of leveling-up work can be shortened.

[0017] In case the laser survey equipment of such composition is used, it is good also as what has a bellows-like configuration for the aforementioned elastic member, and is good also considering the liquid which forms the aforementioned solution layer as a silicone oil.

[0018] moreover, the laser survey equipment of the above-mentioned composition -- the [the above 1st and] -- you may have further a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member within a fixed flat surface, by rotating the reflective member which deflects 90 degrees of laser beams which penetrated 2 transparent member, and the aforementioned reflective member

[0019] Furthermore, a beam division means to divide into two or more laser beams the laser beam to which outgoing radiation of the laser survey equipment of the above-mentioned composition was carried out from the aforementioned laser light source, The condenser lens which condenses one of the laser beams divided by the aforementioned beam division means, It is arranged on the focal plane of the aforementioned condenser lens, and has further an optical position detection means to detect the incidence position of the laser beam condensed with the aforementioned condenser lens. the aforementioned control means -- the [aforementioned] -- the [1 transparent member and / aforementioned] -- based on the variation of the incidence position of the aforementioned laser beam which carried out incidence to the aforementioned optical position detection means, you may compute the size of the angle which 2 transparent member makes

[0020] If the laser survey equipment of such composition is adopted, the size of the angle which each transparent member makes can be made to be able to respond to the variation of the incidence position to the optical position sensing element of the beam divided by the beam division means, and can be detected. Therefore, the sense of a beam shaft can be adjusted more precisely.

[0021] Moreover, the 2nd mode of the laser survey equipment of this invention A laser light source and the 1st wedge glass which penetrates the laser beam by which outgoing radiation was carried out from the aforementioned laser light source while being held in a lens-barrel possible [rotation] centering on the beam shaft of this laser beam, The 2nd wedge glass which penetrates the laser beam which penetrated the aforementioned 1st wedge glass while being held in a lens-barrel possible [rotation] centering on the beam shaft of the aforementioned laser beam, the [the above 1st held in the aforementioned lens-barrel, and] -- with the rolling mechanism which rotates 2 wedge glass the size of the aforementioned tilt angle detected in the level detector which detects the tilt angle to the

level surface of the aforementioned lens-barrel, and the aforementioned level detector -- responding -- the aforementioned rolling mechanism -- controlling -- the [the above 1st and] -- it has the control means which adjust the direction of outgoing radiation of the laser beam which penetrates 2 wedge glass

[0022] That is, the laser survey equipment of the 2nd mode can arrange the wedge glass of two sheets on the optical path of a laser beam, and can adjust the sense of the beam shaft of a laser beam by rotating each wedge glass in the field which intersects perpendicularly with the optical path of the laser beam concerned. Thereby, like the 1st mode, the structure of laser survey equipment can be simplified and, moreover, the time of leveling-up work can be shortened.

[0023] such laser survey equipment of composition -- the [the above 1st and] -- you may have further a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member within a fixed flat surface, by rotating the reflective member which deflects 90 degrees of laser beams which penetrated 2 wedge glass, and the aforementioned reflective member

[0024] Moreover, a beam division means to divide into two or more laser beams the laser beam to which outgoing radiation of the laser survey equipment of the 2nd mode was carried out from the aforementioned laser light source, The condenser lens which condenses one of the laser beams divided by the aforementioned beam division means, It is arranged on the focal plane of the aforementioned condenser lens, and has further an optical position detection means to detect the incidence position of the laser beam condensed with the aforementioned condenser lens. the aforementioned control means -- the [the above 1st and] -- according to the variation of the incidence position of the aforementioned laser beam which carried out incidence to the aforementioned optical position detection means, you may control rotation of 2 wedge glass

[0025] In case the laser survey equipment of each above-mentioned mode is used, the aforementioned beam division means may be a beam splitter which reflects the remainder while penetrating a part of incident light, and the aforementioned optical position detection means may be a two-dimensional position sensitive detector (PSD).

[0026] Furthermore, the laser survey equipment of each above-mentioned mode may be further equipped with a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member within a fixed flat surface, by rotating the reflective member which deflects other one [90-degree] of the laser beams divided by the aforementioned beam division means, and the aforementioned reflective member. At this time, the aforementioned reflective member may be a pentaprism. Moreover, the tilt angle detected in the aforementioned level detector may be equivalent to the inclination to the vertical of the beam shaft of the laser beam which it is divided by the aforementioned beam division means, and carries out incidence to the aforementioned reflective member at this time.

[0027]

[Embodiments of the Invention] Hereafter, the operation gestalt of this invention is explained based on a drawing.

<1st operation gestalt> drawing 1 is the cross section showing the composition of the floodlighting equipment which constitutes the laser survey equipment by the 1st operation gestalt of this invention. This drawing 1 shows the state of the floodlighting equipment when standing laser survey equipment in the perpendicular direction, in order to perform the laser beam scan to a horizontal direction.

[0028] Floodlighting equipment 11 is constituted from that rotation is free and the rotation floodlighting section 15 held at the same axle by the lens-barrel 14 through the lens-barrel 14 fixed in housing (not shown) of laser survey equipment, and bearing 19. Laser beam optical-path 14b in alignment with the machine shaft lz (axis of rotation of the rotation floodlighting section 15 and coincidence) and laser beam optical-path 14a which intersects perpendicularly with this laser beam optical-path 14b are formed in the lens-barrel 14. Moreover, while it is open for free passage to laser beam optical-path 15a of the hollow formed in the axis of rotation and same axle while it was open for free passage to laser beam optical-path 14b, and this laser beam optical-path 15a, pentaprism stowage 15b which has opening is formed in the direction of an end face, and the side at the rotation floodlighting section 15.

[0029] (Laser outgoing radiation optical system) The beam splitter 24 as a beam division means is

being fixed to the intersection of the laser beam optical paths 14a and 14b in a lens-barrel 14. Moreover, the laser diode 21 is being fixed to one edge of this laser beam optical-path 14a. Moreover, between this laser diode 21 and beam splitter 24, a collimator lens 22, the ANAMO prism 23, and the beam shaft controller 33 are being fixed from the laser diode 21 side. Moreover, a pentaprism 27 and the wedge prism 30 are being fixed to pentaprism hold section 15b of the rotation floodlighting section 15.

[0030] The laser diode 21 as a laser light source carries out outgoing radiation of the laser beam L0. A collimator lens 22 is a lens which makes parallel light the laser beam L0 by which outgoing radiation was carried out from laser diode 21. Moreover, the ANAMO prism 23 is an optical element for correcting to a perfect circle form the cross-section configuration of the laser beam L0 which penetrated the collimator lens 22.

[0031] The laser beam L0 which penetrated the ANAMO prism 23 penetrates the optical-axis controller 33, and it carries out incidence to a beam splitter 24 (the optical-axis controller 33 is explained in full detail behind). In the beam splitter 24, partial transparency film 24a which inclined to the pentaprism 27 side 45 degrees to the beam shaft of a laser beam L0 is formed. It has the property of reflecting the remaining laser beam while it makes 20 - 30% of the laser beam L0 penetrate, since this partial transparency film 24a has 70 - 80% of reflection factor. Therefore, 70 - 80% of the laser beam L0 which penetrated the ANAMO prism 23 is reflected in a pentaprism 27 side.

[0032] Incidence of the laser beam L1 which reflected this beam splitter 24 is carried out to the pre-group lens 25 and the back group lens 26 which were fixed in laser beam optical-path 14b. These pre-group lens 25 and the back group lens 26 constitute the beam expander to which the beam diameter of the laser beam L1 by which incidence was carried out is expanded.

[0033] In pentaprism hold section 15b of the rotation floodlighting section 15, the pentaprism 27 in which the laser beam L1 which penetrated the back group lens 26 carries out incidence is being fixed so that it may rotate to this rotation floodlighting section 15 and one. Optical plane-of-incidence 27c to which a laser beam L1 carries out incidence of this pentaprism 27, 1st reflector 27a which the laser beam which carried out incidence from this optical plane-of-incidence 27c while 22.5 degrees leaned to this optical plane-of-incidence 27c reflects, 2nd reflector 27b which reflects again the laser beam reflected by this 1st reflector 27a while 45 degrees leaned to this 1st reflector 27a, While making the right angle to optical plane-of-incidence 27c, it has 27d of optical outgoing radiation sides which carry out outgoing radiation of the laser beam L3 reflected by 2nd reflector 27b. in addition, it does not illustrate to 2nd reflector 27b -- an increase -- reflection -- a film -- since it is formed of the vacuum plating of aluminium, in this 2nd reflector 27b, internal reflection of the laser beam is carried out 100% On the other hand, the partial transparency film whose reflection factor is 70 - 80% is formed in 1st reflector 27a. Therefore, 20 - 30% of laser beam L2 penetrates this 1st reflector 27a, and outgoing radiation is carried out from the upper limit of floodlighting equipment 12 through the wedge prism 30.

[0034] From 27d of optical outgoing radiation sides of a pentaprism 27, the laser beam L3 by which outgoing radiation was carried out penetrates aperture 15for floodlighting c which carried out opening, and the aperture of housing which is not illustrated to the side of pentaprism hold section 15b, and outgoing radiation is carried out to it. Thus, the laser beam L3 by which outgoing radiation was carried out projects the datum line perpendicular to a wall surface etc., or horizontal by rotating in the field where a laser beam L1 and a pentaprism 27 cross at right angles the whole rotation floodlighting section 15.

[0035] (Rolling mechanism) Next, the mechanism (rotation means) for rotating the rotation floodlighting section 15 to a lens-barrel 14 is explained. The gear 35 is being fixed to the peripheral face of the rotation floodlighting section 15 connected free [rotation] to the lens-barrel 14 through bearing 19. On the other hand, the bracket 36 made to project towards the method of outside is formed in the upper-limit side of a lens-barrel 14. The motor 37 for floodlighting section rotation is being fixed to this bracket 36, and the pinion 38 attached in the axis of rotation of this motor 37 for floodlighting section rotation has geared with the gear 35 of the rotation floodlighting section 15. Since the direction of outgoing radiation of the laser beam L3 by which outgoing radiation is carried out from aperture 15for floodlighting c by rotating this motor 37 for floodlighting section rotation

rotates focusing on the axis of rotation of the rotation floodlighting section 15, the base plane which intersects perpendicularly with this axis of rotation is formed.
[0036] (Leveling-up mechanism) As mentioned above, in order to project the datum line perpendicular to a wall surface etc., or horizontal by the laser beam L3, the direction of outgoing radiation of a laser beam L3 needs to be adjusted correctly. For example, in the state of drawing 1 , it must be correctly projected on the laser beam L3 which projects the horizontal datum line horizontally. Hereafter, the leveling-up mechanism for adjusting the direction of outgoing radiation of such a laser beam L3 is explained.
[0037] Drawing 2 is drawing showing a part of each part material fixed to the lens-barrel 14 for explaining the leveling-up mechanism in the laser survey equipment 10 of drawing 1 . Moreover, drawing 3 is the front view which looked at the beam shaft controller 33 from the beam-splitter 24 side, and drawing 4 is the cross section which met the A-A line of drawing 3 . It is installed in the beam shaft controller 33 so that the circular abbreviation parallel glass 41 and 42 of two sheets as a transparent member may serve as abbreviation parallel mutually, and the periphery portion of these abbreviation parallel glass 41 and 42 is inserted in the annular glass presser-foot frames 45 and 46. 45d of receptacle seats for holding abbreviation parallel glass 41 is formed in the opening edge which counters the glass presser-foot frame 46 of the glass presser-foot frame 45. Similarly, 46d of receptacle seats for holding abbreviation parallel glass 42 is formed in the opening edge which counters the glass presser-foot frame 45 of the glass presser-foot frame 46.
[0038] Covering 43 (elastic member) has the shape of a cylindrical shape of the shape of bellows which consists of an elastic body, and both the openings edge is closed by pasting the receptacle seats 45d and 46d of the glass presser-foot frames 45 and 46, respectively. And the solution layer 44 is formed in the interior of covering 43 by filling up with liquids, such as a silicone oil.
[0039] On the peripheral face of the glass presser-foot frames 45 and 46, the pin attachment sections 45a and 46a of a rectangle tabular are formed at each glass presser-foot frames 45 and 46 and one. The both ends are formed more thinly than other portions, and the pin 47 is attached so that the pin attachment sections 45a and 46a may be penetrated. For this reason, the distance between each glass presser-foot frame 45 in the portion in which each pin attachment sections 45a and 46a were formed, and 46 is maintained at simultaneously regularity. However, each pin attachment sections 45a and 46a are movable to the shaft orientations of this pin 47 in some range to a pin 47.
[0040] Moreover, on the peripheral face of the glass presser-foot frame 45, two lead screw attaching parts 45b and 45c of a rectangle tabular are formed at this glass presser-foot frame 45 and one. These lead screw attaching parts 45b and 45c and pin attachment section 45a are formed so that it may project in the method of outside from 3 division-into-equal-parts position of the peripheral face of the glass presser-foot frame 45. And on the peripheral face which laps with lead screw attaching part 45b of the glass presser-foot frame 46, lead screw attaching part 46b is formed. Screwhole 46e is formed in lead screw attaching part 46b, and the lead screw 48 is thrust into this screwhole 46e.
[0041] The lead screw 48 is formed more thinly than other portions, and it has edge 48a by which the male screw is not turned off, and this edge 48a is inserted in lead screw attaching part 45b free [rotation]. Since the stopper ring 55 has fitted in, the lead screw 48 is held at edge 48a which penetrated lead screw attaching part 45b so that it may not fall out from lead screw attaching part 45b. And the lead screw 48 rotates through the motor gear 52 which meshes with the lead screw gear 53 fixed at the nose of cam, and this lead screw gear 53 by the motor 51 fixed to lead screw attaching part 45b. Drive control of this motor 51 is carried out by the control section 35. Lead screw attaching part 46b is moved with rotation of the lead screw 48 by this motor 51 in accordance with the shaft orientations (the direction of B of drawing 4) of the lead screw 48. For this reason, the distance between each abbreviation parallel glass 42 in the portion in which the lead screw attaching parts 45b and 46b were formed, and 43 changes. Moreover, the same mechanism as the lead screw attaching parts 45b and 46b is established also about the lead screw attaching parts 45c and 46c. For this reason, the distance between each abbreviation parallel glass 42 in the portion in which lead screw attaching part 45c was formed, and 43 also changes with control sections 35.
[0042] The situation of the optical-axis controller 33 when a motor 51 rotates to drawing 5 is shown. As mentioned above, when a motor 51 rotates, the lead screw 48 rotates and lead screw attaching part 46b moves in accordance with the shaft of this lead screw 48 in connection with this. For this

reason, as shown in drawing 5 , the distance between each abbreviation parallel glass 41 in this portion and 42 becomes small. On the other hand, the distance between each abbreviation parallel glass 41 in the portion in which each pin attachment sections 45a and 46a were formed, and 42 is kept constant by the pin 47. Therefore, each abbreviation parallel glass 41 and 42 will be in the state of countering with some angle from parallel. At this time, the angle (namely, vertical angle of a solution layer 44) which each abbreviation parallel glass 41 and 42 makes is made into theta**, and the refractive index of a solution layer 44 is set to n (however, n**1.5). And if the angle of deviation of the beam shaft of the laser beam L0 by which carries out incidence to abbreviation parallel glass 42, and penetrates a solution layer 44 and outgoing radiation is carried out from abbreviation parallel glass 41 is made into theta'**, the relation of the following formula will be realized.
theta'=(n-1) theta ... (1)
That is, the sense of the beam shaft of the laser beam L0 which penetrates this beam shaft controller 33 can be changed by controlling the size of the vertical angle theta of a solution layer 44.
[0043] Moreover, as shown in drawing 1 and drawing 2 , the two-dimensional position sensitive detector (henceforth "PSD") 29 as an optical position detection means turns the light-receiving side to a beam-splitter 24 side, and is being fixed to the end face which counters the laser diode 21 of laser beam optical-path 14a of a lens-barrel 14. moreover, two-dimensional [in laser beam optical-path 14a] -- the condenser lens 28 is being fixed between PSD29 and the beam splitter 24 The distance between two-dimensional PSD(s)29 is equal to the focal distance f2 of a condenser lens 28 in this condenser lens 28. Therefore, 20 - 30% of laser beam L4 which penetrated partial transparency film 24a among the laser beams L0 which outgoing radiation was carried out from laser diode 21, and carried out incidence to the beam splitter 24 penetrates a condenser lens 28, and is condensed on PSDtwo-dimensional 29. Two-dimensional PSD29 is a device which detects the incidence position of light. The incidence position of the laser beam L4 to two-dimensional PSD is computed based on the current ratio outputted from each of this output terminal of two-dimensional PSD29. In addition, each of this output terminal of two-dimensional PSD is connected to the control section 35.
[0044] Moreover, the tilt sensor 31 (level detector) which detects the inclination of the level shell of x directions (hand of cut within space) is being fixed to the soffit section of laser beam optical-path 14b of a lens-barrel 14. And the tilt sensor 32 which detects the inclination of the level shell (hand of cut in the field which intersects perpendicularly with space along the perpendicular direction) of y is being fixed to the side of the tilt sensor 31. The tilt sensors 31 and 32 detect the inclination of a level shell by regarding position change of the foam in the bubble tube with which the electrolytic solution was filled as a change in resistance, and changing into an electrical signal. That is, while two electrodes (not shown) are prepared in the detection direction of a tilt angle by object physical relationship, respectively, the common electrode is prepared in the inferior-surface-of-tongue whole region on the upper surface of the tilt sensors 31 and 32. Therefore, if the position of a foam changes within each tilt sensor 31 and 32, the ratio of the resistance between each electrode on these upper surfaces and a common electrode will change. Each tilt sensors 31 and 32 are connected to the control section 35 through each [these] electrode, and the variation of the inclination of a lens-barrel 14 is computed based on change of the ratio of the resistance produced in each electrode.
[0045] By using the measuring device which is not illustrated in the state of drawing 2 , the sense of a lens-barrel 14 shall be adjusted so that outgoing radiation of the laser beam L3 may be carried out horizontally correctly and outgoing radiation of the laser beam L1 may be carried out in the perpendicular direction l0. In addition, the beam shaft of a laser beam L1 and the machine shaft lz of a lens-barrel 14 shall be completely in agreement at this time. the measured value of the tilt sensors 31 and 32 at this time, and two-dimensional [of a laser beam L4] -- the incidence position of PSD29 is memorized as initial value to a control section two-dimensional [at this time / of a laser beam L4] -- distance in the x directions of [from the PSD center coordinate a0 of the incidence position of PSD29] is set to a1 Here, since the lens-barrel machine shaft lz and the perpendicular direction l0 are in the state which was completely in agreement, although a value when the measured value by each tilt sensors 31 and 32 has the perpendicular machine shaft lz of a lens-barrel 14 is shown, depending on the physical relationship of the lens-barrel machine shaft lz and the beam shaft of a laser beam L1, this measured value does not necessarily need to show the value at the time of a

vertical.
[0046] Since the beam shaft of a laser beam L1 is perpendicular since the beam shaft of drawing 6 of the laser beam L3 by which outgoing radiation was carried out from 27d of optical outgoing radiation sides of a pentaprism 27 from the state of drawing 2 was level when it +deltaomega** Inclines in the x directions namely, the state +deltaomega** Where it inclined is shown (the clockwise sense is made into + in the x directions of drawing 6). Since it is in the state +deltaomega** Where the machine shaft lz of a lens-barrel 14 inclined from the state of drawing 2 to the perpendicular direction l0 similarly, at this time, the measured value of the tilt sensor 31 also changes from initial value by the inclination of +deltaomega**.
[0047] Then, the measured value of the tilt sensor 31 is read by the control section 35. A control section 35 computes amount of inclinations +deltaomega** of the beam shaft of a laser beam L1 based on the measured value of the tilt sensor 31. Since the motors 51 and 51 of each lead screw attaching parts 45b and 45c of the beam shaft controller 33 rotate and the lead screws 48 and 48 opened for free passage through the motor gears 52 and 52 and the lead screw gears 53 and 53 rotate according to it, respectively, the lead screw attaching parts 46b and 46c are moved to the shaft orientations of the lead screws 48 and 48. Since the size of the vertical angle theta which a solution layer 44 forms changes by this, the direction of outgoing radiation of the beam shaft of a laser beam L1 is adjusted. When the size of the vertical angle theta of a solution layer 44 changes to drawing 7 shows signs that it was adjusted so that the beam shaft of a laser beam L1 might become in the perpendicular direction l0. In order to adjust so that outgoing radiation of the laser beam L1 may be carried out in the perpendicular direction l0, only +deltaomega ** needs to make the beam shaft of the laser beam L0 by which outgoing radiation is carried out incline from the beam shaft controller 33 to the optical axis of a collimator lens 22. two-dimensional [of the laser beam / in / x directions / when the +deltaomega** inclination of the beam shaft of a laser beam L0 is done to the optical axis of a collimator lens 22] L4 / -- the amount b of gaps from the initial value a1 of the incidence position of PSD29 serves as b=f2tan (+deltaomega**) Drive control of each motors 51 and 51 is carried out. therefore, the control section 33 -- two-dimensional, always carrying out the monitor of the incidence position of the laser beam L4 outputted from PSD29 The vertical angle theta of the solution layer 44 of the beam shaft controller 33 is changed so that the gap of the x directions of [from the main coordinate a0 of the incidence position of a laser beam L4] which carries out incidence to two-dimensional PSD29 may serve as a1+b=a1+f2tan (+deltaomega**). The vertical angle theta of the solution layer 44 at this time is theta=theta'/(n-1) from (1) formula.
= deltaomega/(n-1) (however, n refractive index of a solution layer 44)
It changes so that it may become. Thereby, only -deltaomega ** inclines from the state of drawing 6 , and the beam shaft of a laser beam L1 is in agreement with the perpendicular direction l0. Therefore, it is adjusted so that the beam shaft of the laser beam L3 by which outgoing radiation is carried out from the rotation floodlighting section 15 may become level.
[0048] In addition, although only adjustment of the x directions of the inclination of the beam shaft of a laser beam L1 detected by the tilt sensor 31 was explained, adjustment of the beam shaft of the direction of y detected by the tilt sensor 32 is performed similarly here.
[0049] That is, with the laser survey equipment of this operation gestalt, the direction of outgoing radiation of a laser beam L1 is adjusted by adjusting the size of the vertical angle theta of the solution layer 44 of the beam shaft controller 33 according to the inclination of the level shell of the base plane formed of a laser beam L3. moreover, two-dimensional [which installed change of the sense of each beam shaft at the time of making the beam shaft controller 33 drive on the optical axis of a collimator lens 22] -- it is supervising with the incidence position of the laser beam L4 of PSD29 For this reason, variation with the slight sense of the beam shaft L0 by the beam shaft controller 33 can be adjusted with high precision.
[0050] Thus, since the laser survey equipment of this operation gestalt is performing the leveling up by changing the relative angle of the abbreviation parallel glass 41 and 42 of two sheets which closed the solution layer 44, it does not need the complicated structure for leaning the whole lens-barrel like before. For this reason, structure of laser survey equipment can be simplified. Moreover, since the laser survey equipment of this operation gestalt does not need to lean floodlighting equipment 11 to housing in the case of a leveling up, the measured value of the tilt sensors 31 and 32

does not change in the middle of leveling-up work. Therefore, since time for stabilizing the measured value of a tilt sensor is not needed like before, leveling-up work can be done in a short time.

[0051] The leveling-up mechanism of the laser survey equipment in the 2nd operation gestalt of this invention and some laser outgoing radiation optical system are shown in <2nd operation gestalt> drawing 8 . A **** 2 operation gestalt is applied, when leaning 90 degrees of lens-barrels 14 in the perpendicular direction and using them for it to the state of drawing 1 , in order to carry out a laser scan.

[0052] Where 90 degrees is leaned in the x directions to the state of drawing 1 , the tilt sensor 61 of x directions (hand of cut within space) is being fixed so that the beam shaft orientations of a laser beam L1 may become horizontal direction l0'. and the 1st operation gestalt -- the same -- the tilt sensor 61 of x directions -- the beam shaft controller 33 and two-dimensional -- it connects with the control section 53 with PSD29

[0053] Hereafter, operation of the leveling-up mechanism of the laser survey equipment of this operation gestalt is explained. First, a control section 53 remembers the incidence position of the laser beam L4 to two-dimensional PSD29 to be the measured value of the tilt sensor 61 when being adjusted like drawing 8 , so that the beam shaft of a laser beam L1 may become horizontal direction l0'. In addition, the beam shaft of a laser beam L1 and machine shaft lz' of a lens-barrel 14 shall be completely in agreement at this time. this time -- two-dimensional [of a laser beam L4] -- distance in the x directions of [from the PSD center a0 of the incidence position of PSD29] is set to a2 +deltaomega** As shown in drawing 9 , the beam shaft of a laser beam L1 in the x directions from horizontal direction l0' and when it shifts a control section 53 -- two-dimensional -- so that the distance from the PSD center a0 of the incidence position of the x directions of the laser beam L4 of PSD29 may serve as a2+f2tan (+deltaomega) The angle of the abbreviation parallel glass 42 to the abbreviation parallel glass 41 of the beam shaft controller 33 is changed, and the beam shaft orientation of a laser beam L0 is adjusted. Thus, -deltaomega** rotation [state / of drawing 9] of the beam shaft of a laser beam L1 can be done, and it can adjust so that horizontal direction l0' may be made to turn to (refer to drawing 10).

[0054] Thus, in order to perform the laser scan of the perpendicular direction, even when using laser survey equipment with this operation form, turning it horizontally, leveling-up work is done using the beam shaft controller 33 to which the beam shaft orientation of a laser beam L0 is adjusted by changing the relative angle of the abbreviation parallel glass 41 and 42 of two sheets which closed the solution layer 44 like the 1st operation form. Thereby, the sense of the beam shaft of a laser beam L0 is made to incline to lens-barrel machine shaft lz', and it can adjust so that the beam shaft of a laser beam L1 may become level.

[0055] <3rd operation gestalt> drawing 11 is the cross section showing the structure of the beam shaft controller 63 in the laser survey equipment of the 3rd operation gestalt of this invention. the laser survey equipment of a **** 3 operation gestalt does leveling-up work by adjusting the sense of the beam shaft of a laser beam L0 by rotating the optical axis of a collimator lens 22 for the wedge glass of two sheets as a center, respectively -- the feature -- carrying out -- other portions -- the [the 1st and] -- suppose that it is the same as that of 2 operation gestalten

[0056] The beam shaft controller 63 fixed in laser beam optical-path 14a of a lens-barrel 14 consists of casing 66 of an enclosed type which consists of a transparent member, and wedge glass 64 and 65 of two sheets held in this casing 66. Wedge glass 64 and 65 is an optical element which consists of a flat surface which faced with the angle more slightly than parallel, and it arranges and it is arranged so that those plane of incidence may be turned to a laser diode 21 side. It is held in casing 66 in the state which each [these] wedge glass 64 and 65 can rotate freely in a field perpendicular to the optical axis of a collimator lens 22. Moreover, 64 of each wedge glass and the axis of rotation of 65 are constituted so that it may be in agreement with the optical axis of a collimator lens 22. Gears 67 and 68 have fitted into the periphery portion of each [these] wedge glass 64 and 65, respectively, and each gears 67 and 68 are rotated by the motors 69 and 70 fixed in casing 66 into it. Each [these] motors 69 and 70 are connected to the control section 35, and the roll control of each wedge glass 64 and 65 is made by this control section 35. In addition, with this operation gestalt, each gears 67 and 68 and each motors 69 and 70 are combined, and it is considering as the "rolling mechanism."

[0057] When incidence of the laser beam L0 is carried out to this beam shaft controller 63, the beam shaft of this laser beam L0 is crooked by penetrating the wedge glass 64 and 65 of two sheets. And if each wedge glass 64 and 65 rotates by the control section 35, the sense of the beam shaft of the laser beam L0 which penetrates the beam shaft controller 63 will change. Thus, by adjusting the sense of the beam shaft of a laser beam L0, it can adjust so that outgoing radiation of the beam shaft of a laser beam L1 may be carried out in the perpendicular direction l0.
[0058] Hereafter, the leveling-up method of the laser survey equipment of this operation gestalt using the beam shaft controller 63 of the above-mentioned composition is explained using drawing 2 , and 6, 7 and 11. As mentioned above, the sense of a lens-barrel 14 is adjusted so that outgoing radiation of the laser beam L3 may be horizontally carried out correctly by the measuring device which is not illustrated and outgoing radiation of the laser beam L1 may be carried out in the perpendicular direction l0 (at this time, the beam shaft of a laser beam L1 and the machine shaft lz of a lens-barrel 14 are completely in agreement). the measured value of the tilt sensors 31 and 32 at this time, and two-dimensional [of a laser beam L4] -- the incidence position of PSD29 is memorized by the control section 35 the 1st operation gestalt -- the same -- two-dimensional [of the laser beam L4 at this time] -- distance from the PSD center a0 of the incidence position of PSD29 is set to a1 As shown in drawing 6 , the beam shaft of a laser beam L1 receives in the perpendicular direction l0. +deltaomega** and when it shifts The roll control of each motors 69 and 70 is performed. a control section 35 -- two-dimensional -- so that the distance from the PSD center a0 of the incidence position of the x directions of the laser beam L4 of PSD29 may serve as a1+f2tan (+deltaomega**) The sense of the beam shaft of the laser beam L0 by which incidence is carried out to a beam splitter 24 is adjusted by rotating each wedge glass 64 and 65 in the field which intersects perpendicularly with the optical axis of a collimator lens 22. Thus, -deltaomega** rotation [state / of drawing 6] of the beam shaft of a laser beam L1 can be done, and it can adjust so that the perpendicular direction l0 may be made to turn to (drawing 7).
[0059] In addition, although the leveling-up mechanism at the time of standing laser survey equipment perpendicularly and using it like drawing 1 was explained in order to perform a horizontal laser scan here, in case the laser scan to the perpendicular direction is performed, the same leveling-up work can be done by fixing, where 90 degrees of tilt sensors 31 are rotated from the state of drawing 1 like the 2nd operation gestalt.
[0060]
[Effect of the Invention] According to this invention, a complicated leveling-up mechanism is not needed but the structure of laser survey equipment can be simplified. Moreover, the laser survey equipment which can do leveling-up work in a short time can be offered.

[Translation done.]

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates the datum line by the laser beam to horizontal or the laser survey equipment projected perpendicularly to a predetermined field.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Conventionally, in fields, such as engineering works and construction, the laser survey equipment (the so-called laser planar) for performing marking of a horizontal line or a vertical line is used. This laser equipment rotates the floodlighting section which carries out outgoing radiation of the laser beam, scans this laser beam to a hoop direction, and projects the datum line perpendicular to planes of incidence-ed, such as a wall surface, or horizontal by tracing of a laser beam.
[0003] Drawing 12 is the cross section showing the composition of conventional laser survey equipment. This drawing 12 shows the state where laser survey equipment was stood in the perpendicular direction, in order to perform the laser beam scan to a horizontal direction. The lens-barrel 82 dedicated in housing 81 consists of laser beam optical-path 82a of the hollow which branched at the right angle from laser beam optical-path 82b of the hollow which penetrates the whole along with the medial axis of laser survey equipment, and this laser beam optical-path 82b. In laser beam optical-path 82a, a laser diode 83, the collimator lens unit 104, and the ANAMO prism 84 are being fixed from the end-face side. And the rectangular prism 85 is being fixed to the intersection of the laser beam optical paths 82a and 82b.
[0004] In laser beam optical-path 82b, the pre-group lens 86 and the back group lens 87 are being fixed toward the upper part in drawing 12 from the rectangular prism 85. The approximate circle tubed rotation floodlighting section 88 to which the pentaprism 89 was dedicated is being fixed to the upper-limit section of a lens-barrel 82 free [rotation] in the field which intersects perpendicularly with laser beam optical-path 82b. Opening is formed in the upper-limit side and the side of this rotation floodlighting section 88, respectively.
[0005] In the laser survey equipment of such composition, if outgoing radiation of the laser beam L10 is carried out from the laser diode 83 fixed to the laser beam optical-path 82a end face, in a rectangular prism 85, 90 degrees of the laser beam L10 will be crooked in the rotation floodlighting section 88 side, it will penetrate the pre-group lens 86 and the back group lens 87, and they will carry out incidence to a pentaprism 89. The laser beam L10 which carried out incidence to the pentaprism 89 is gradually reflected by 2nd reflector 89b which inclined 45 degrees to 1st reflector 89a and this 1st reflector. And outgoing radiation of the laser beam L11 which reflector [1st] 89a Reached and was reflected by 2nd reflector 89b is carried out from optical outgoing radiation side 89c which is making the right angle to 89d of optical plane of incidence.
[0006] Moreover, the partial reflection film is formed in 1st reflector 89a. Therefore, some laser beams L12 penetrate this 1st reflector 89a, penetrate the wedge prism 90 fixed on this 1st reflector 89a, and outgoing radiation is carried out from opening of a rotation floodlighting section 88 upper-limit side.
[0007] And a laser beam L11 rotates focusing on the axis of rotation of the rotation floodlighting section 88 by rotating in the field where laser beam optical-path 82b and the rotation floodlighting section 88 cross at right angles. Therefore, the base plane which intersects perpendicularly with this axis of rotation is formed of a laser beam L11. Moreover, the laser beam L12 by which outgoing radiation is carried out from the upper limit of the rotation floodlighting section 88 forms the criteria spot for a survey control point etc. being shown in a ceiling etc.
[0008] Thus, in order to form a base plane in a wall surface etc., outgoing radiation of the laser beam L11 by which outgoing radiation was carried out from laser survey equipment needs to be carried out

horizontally correctly. Similarly, outgoing radiation also of the laser beam L12 which forms a criteria spot needs to be correctly carried out to a ceiling etc. perpendicularly. Therefore, at the time of use of laser survey equipment, it is necessary to do leveling-up work so that outgoing radiation of the laser beam L11 may be carried out horizontally correctly.

[0009] Hereafter, the leveling-up mechanism for outgoing radiation of the laser beam L11 being carried out horizontally correctly is explained. sliding which the bulge section 91 which has a semi-sphere side configuration is formed in the upper-limit side of a lens-barrel 82, and was formed in housing 81 -- a hole -- it is held in the state where it contacted in 81a since the maintenance to the housing 81 of a lens-barrel 82 is made by only contact of this portion -- sliding -- a hole -- the lens-barrel 82 whole can be made to tilt in all the directions by rotating the semi-sphere side portion of the bulge section 91 within 81a

[0010] Moreover, in housing 81, the screw 97 rotated by the motor 98 for level adjustment is formed. The nut 99 is screwed in this screw 97. This nut 99 moves up and down with rotation of a screw 97. The operation pin 101 is projected and formed in the superficies of a nut 99. The drive arm 96 formed in the bulge section 91 and the pin 100 open for free passage touch the operation pin 101, and, thereby, rotation of the direction of X of the bulge section 91 (hand of cut within space) is regulated.

[0011] Furthermore, under the rectangular prism 85, the tilt sensor 103 of the direction of X which detects the inclination of the direction of X of a lens-barrel 82 is being fixed in the lens-barrel 82. According to the inclination detected by this tilt sensor 103, the roll control of the motor 98 for level adjustment is performed, and a screw 97 rotates by this. Then, a nut 99 moves up and down with rotation of this screw 97, and the bulge section 91 linked through the operation pin 101 and the pin 100 rotates in the direction of X. In addition, the tilt sensor 102 of the direction of Y which detects the inclination of the direction (hand of cut in the field which intersects perpendicularly with space along the perpendicular-among drawing direction) of Y is being fixed to the side of the tilt sensor of the direction of X. Moreover, although not shown in the drawing, in housing 81, the mechanism for regulating rotation of the direction of Y of the bulge section 91 as well as the direction of X is established according to the size of the inclination detected by the tilt sensor 102. Thus, it is adjusted so that a lens-barrel 82 may always turn to the perpendicular direction, namely, so that outgoing radiation of the laser beam L11 may always be carried out horizontally. Therefore, a laser beam L11 can form always exact datum level.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, a complicated leveling-up mechanism is not needed but the structure of laser survey equipment can be simplified. Moreover, the laser survey equipment which can do leveling-up work in a short time can be offered.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, with the structure of conventional laser survey equipment which was mentioned above, the leveling-up work for carrying out outgoing radiation of the laser beam L11 horizontally is done by leaning a lens-barrel 82 using the motor 98 for level adjustment, a screw 97, and nut 99 grade. For this reason, there was a problem that the structure of laser survey equipment will become complicated.
[0013] Moreover, if an inclination changes, the tilt sensor 102,103 will require fixed time until the measured value is stabilized possible [measurement]. For this reason, you have to wait to stabilize the measured value of the tilt sensor 102,103, whenever the inclination of a lens-barrel 82 changes, when adjustment by leaning a lens-barrel 82 like before is performed. For this reason, the long time was required in order to do leveling-up work.
[0014] Then, structure for a leveling up can be simplified and let it be the technical problem of this invention to offer the laser survey equipment which can moreover do leveling-up work in a short time.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the 1st mode of the laser survey equipment of this invention the [which has been arranged on the optical path of the laser beam by which outgoing radiation was carried out from the laser light source and the aforementioned laser light source / abbreviation plate-like / the 1st and] -- with 2 transparent member the [the above 1st and] -- with the tubed elastic member by which the double door peristome was closed by 2 transparent member the [the solution layer formed by filling up with a liquid in the aforementioned elastic member, and / the above 1st and] -- with the lens-barrel holding 2 transparent member The adjustment mechanism the above 1st held at this lens-barrel and whose adjustment in the range which includes parallel for the relative tilt angle of a member the 2nd transparence are enabled, The aforementioned adjustment mechanism is controlled according to the size of the aforementioned tilt angle detected in the level detector which detects the tilt angle to the level surface of the aforementioned lens-barrel, and the aforementioned level detector, and it has the control means which adjust the size of the angle which the aforementioned 1st area-pellucida material and the aforementioned 2nd area-pellucida material make.

[0016] That is, the unit which closed the elastic member by the 1st and 2nd transparent members, and filled up the liquid with the laser survey equipment of the 1st mode into it is arranged on the optical path of a laser beam. And the sense of the beam shaft which penetrates each [these] transparent member is changed by changing the angle which each transparent member makes according to the size of the inclination of the level shell of the lens-barrel detected in the level detector. Therefore, since it is not necessary to establish like before the complicated leveling-up mechanism in which a lens-barrel is leaned, the structure of laser survey equipment can be simplified. Moreover, with the laser survey equipment of the 1st mode, since it is accepted by changing the size of the angle which each transparent member makes and the sense of a beam shaft is adjusted, it is not necessary to change the sense of the whole lens-barrel. Therefore, since the measured value of a level detector is always fixed, in case it does leveling-up work like before through leveling-up work, it does not require time until the measured value of a level detector is stabilized. Therefore, the time of leveling-up work can be shortened.

[0017] In case the laser survey equipment of such composition is used, it is good also as what has a bellows-like configuration for the aforementioned elastic member, and is good also considering the liquid which forms the aforementioned solution layer as a silicone oil.

[0018] moreover, the laser survey equipment of the above-mentioned composition -- the [the above 1st and] -- you may have further a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member within a fixed flat surface, by rotating the reflective member which deflects 90 degrees of laser beams which penetrated 2 transparent member, and the aforementioned reflective member

[0019] Furthermore, a beam division means to divide into two or more laser beams the laser beam to which outgoing radiation of the laser survey equipment of the above-mentioned composition was carried out from the aforementioned laser light source, The condenser lens which condenses one of the laser beams divided by the aforementioned beam division means, It is arranged on the focal plane of the aforementioned condenser lens, and has further an optical position detection means to detect the incidence position of the laser beam condensed with the aforementioned condenser lens. the aforementioned control means -- the [aforementioned] -- the [1 transparent member and /

aforementioned] -- based on the variation of the incidence position of the aforementioned laser beam which carried out incidence to the aforementioned optical position detection means, you may compute the size of the angle which 2 transparent member makes

[0020] If the laser survey equipment of such composition is adopted, the size of the angle which each transparent member makes can be made to be able to respond to the variation of the incidence position to the optical position sensing element of the beam divided by the beam division means, and can be detected. Therefore, the sense of a beam shaft can be adjusted more precisely.

[0021] Moreover, the 2nd mode of the laser survey equipment of this invention A laser light source and the 1st wedge glass which penetrates the laser beam by which outgoing radiation was carried out from the aforementioned laser light source while being held in a lens-barrel possible [rotation] centering on the beam shaft of this laser beam, The 2nd wedge glass which penetrates the laser beam which penetrated the aforementioned 1st wedge glass while being held in a lens-barrel possible [rotation] centering on the beam shaft of the aforementioned laser beam, the [the above 1st held in the aforementioned lens-barrel, and] -- with the rolling mechanism which rotates 2 wedge glass the size of the aforementioned tilt angle detected in the level detector which detects the tilt angle to the level surface of the aforementioned lens-barrel, and the aforementioned level detector -- responding -- the aforementioned rolling mechanism -- controlling -- the [the above 1st and] -- it has the control means which adjust the direction of outgoing radiation of the laser beam which penetrates 2 wedge glass

[0022] That is, the laser survey equipment of the 2nd mode can arrange the wedge glass of two sheets on the optical path of a laser beam, and can adjust the sense of the beam shaft of a laser beam by rotating each wedge glass in the field which intersects perpendicularly with the optical path of the laser beam concerned. Thereby, like the 1st mode, the structure of laser survey equipment can be simplified and, moreover, the time of leveling-up work can be shortened.

[0023] such laser survey equipment of composition -- the [the above 1st and] -- you may have further a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member within a fixed flat surface, by rotating the reflective member which deflects 90 degrees of laser beams which penetrated 2 wedge glass, and the aforementioned reflective member

[0024] Moreover, a beam division means to divide into two or more laser beams the laser beam to which outgoing radiation of the laser survey equipment of the 2nd mode was carried out from the aforementioned laser light source, The condenser lens which condenses one of the laser beams divided by the aforementioned beam division means, It is arranged on the focal plane of the aforementioned condenser lens, and has further an optical position detection means to detect the incidence position of the laser beam condensed with the aforementioned condenser lens. the aforementioned control means -- the [the above 1st and] -- according to the variation of the incidence position of the aforementioned laser beam which carried out incidence to the aforementioned optical position detection means, you may control rotation of 2 wedge glass

[0025] In case the laser survey equipment of each above-mentioned mode is used, the aforementioned beam division means may be a beam splitter which reflects the remainder while penetrating a part of incident light, and the aforementioned optical position detection means may be a two-dimensional position sensitive detector (PSD).

[0026] Furthermore, the laser survey equipment of each above-mentioned mode may be further equipped with a rotation means to rotate the direction of outgoing radiation of the laser beam deflected by this reflective member within a fixed flat surface, by rotating the reflective member which deflects other one [90-degree] of the laser beams divided by the aforementioned beam division means, and the aforementioned reflective member. At this time, the aforementioned reflective member may be a pentaprism. Moreover, the tilt angle detected in the aforementioned level detector may be equivalent to the inclination to the vertical of the beam shaft of the laser beam which it is divided by the aforementioned beam division means, and carries out incidence to the aforementioned reflective member at this time.

[0027]

[Embodiments of the Invention] Hereafter, the operation gestalt of this invention is explained based on a drawing.

<1st operation gestalt> drawing 1 is the cross section showing the composition of the floodlighting equipment which constitutes the laser survey equipment by the 1st operation gestalt of this invention. This drawing 1 shows the state of the floodlighting equipment when standing laser survey equipment in the perpendicular direction, in order to perform the laser beam scan to a horizontal direction.
[0028] Floodlighting equipment 11 is constituted from that rotation is free and the rotation floodlighting section 15 held at the same axle by the lens-barrel 14 through the lens-barrel 14 fixed in housing (not shown) of laser survey equipment, and bearing 19. Laser beam optical-path 14b in alignment with the machine shaft lz (axis of rotation of the rotation floodlighting section 15 and coincidence) and laser beam optical-path 14a which intersects perpendicularly with this laser beam optical-path 14b are formed in the lens-barrel 14. Moreover, while it is open for free passage to laser beam optical-path 15a of the hollow formed in the axis of rotation and same axle while it was open for free passage to laser beam optical-path 14b, and this laser beam optical-path 15a, pentaprism stowage 15b which has opening is formed in the direction of an end face, and the side at the rotation floodlighting section 15.
[0029] (Laser outgoing radiation optical system) The beam splitter 24 as a beam division means is being fixed to the intersection of the laser beam optical paths 14a and 14b in a lens-barrel 14. Moreover, the laser diode 21 is being fixed to one edge of this laser beam optical-path 14a. Moreover, between this laser diode 21 and beam splitter 24, a collimator lens 22, the ANAMO prism 23, and the beam shaft controller 33 are being fixed from the laser diode 21 side. Moreover, a pentaprism 27 and the wedge prism 30 are being fixed to pentaprism hold section 15b of the rotation floodlighting section 15.
[0030] The laser diode 21 as a laser light source carries out outgoing radiation of the laser beam L0. A collimator lens 22 is a lens which makes parallel light the laser beam L0 by which outgoing radiation was carried out from laser diode 21. Moreover, the ANAMO prism 23 is an optical element for correcting to a perfect circle form the cross-section configuration of the laser beam L0 which penetrated the collimator lens 22.
[0031] The laser beam L0 which penetrated the ANAMO prism 23 penetrates the optical-axis controller 33, and it carries out incidence to a beam splitter 24 (the optical-axis controller 33 is explained in full detail behind). In the beam splitter 24, partial transparency film 24a which inclined to the pentaprism 27 side 45 degrees to the beam shaft of a laser beam L0 is formed. It has the property of reflecting the remaining laser beam while it makes 20 - 30% of the laser beam L0 penetrate, since this partial transparency film 24a has 70 - 80% of reflection factor. Therefore, 70 - 80% of the laser beam L0 which penetrated the ANAMO prism 23 is reflected in a pentaprism 27 side.
[0032] Incidence of the laser beam L1 which reflected this beam splitter 24 is carried out to the pre-group lens 25 and the back group lens 26 which were fixed in laser beam optical-path 14b. These pre-group lens 25 and the back group lens 26 constitute the beam expander to which the beam diameter of the laser beam L1 by which incidence was carried out is expanded.
[0033] In pentaprism hold section 15b of the rotation floodlighting section 15, the pentaprism 27 in which the laser beam L1 which penetrated the back group lens 26 carries out incidence is being fixed so that it may rotate to this rotation floodlighting section 15 and one. Optical plane-of-incidence 27c to which a laser beam L1 carries out incidence of this pentaprism 27, 1st reflector 27a which the laser beam which carried out incidence from this optical plane-of-incidence 27c while 22.5 degrees leaned to this optical plane-of-incidence 27c reflects, 2nd reflector 27b which reflects again the laser beam reflected by this 1st reflector 27a while 45 degrees leaned to this 1st reflector 27a, While making the right angle to optical plane-of-incidence 27c, it has 27d of optical outgoing radiation sides which carry out outgoing radiation of the laser beam L3 reflected by 2nd reflector 27b. in addition, it does not illustrate to 2nd reflector 27b -- an increase -- reflection -- a film -- since it is formed of the vacuum plating of aluminium, in this 2nd reflector 27b, internal reflection of the laser beam is carried out 100% On the other hand, the partial transparency film whose reflection factor is 70 - 80% is formed in 1st reflector 27a. Therefore, 20 - 30% of laser beam L2 penetrates this 1st reflector 27a, and outgoing radiation is carried out from the upper limit of floodlighting equipment 12 through the wedge prism 30.
[0034] From 27d of optical outgoing radiation sides of a pentaprism 27, the laser beam L3 by which

outgoing radiation was carried out penetrates aperture 15for floodlighting c which carried out opening, and the aperture of housing which is not illustrated to the side of pentaprism hold section 15b, and outgoing radiation is carried out to it. Thus, the laser beam L3 by which outgoing radiation was carried out projects the datum line perpendicular to a wall surface etc., or horizontal by rotating in the field where a laser beam L1 and a pentaprism 27 cross at right angles the whole rotation floodlighting section 15.

[0035] (Rolling mechanism) Next, the mechanism for rotating the rotation floodlighting section 15 to a lens-barrel 14

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The cross section showing the structure of the laser survey equipment by the 1st operation gestalt of this invention
[Drawing 2] Drawing for explaining the leveling-up mechanism of the laser survey equipment by the 1st operation gestalt of this invention
[Drawing 3] Front view of the beam shaft controller 33 in the laser survey equipment by the 1st operation gestalt of this invention
[Drawing 4] The cross section which met the A-A line of drawing 3
[Drawing 5] The cross section showing the state of the beam shaft controller 33 when rotating a motor 51
[Drawing 6] Drawing showing signs +deltaomega** That the beam shaft of a laser beam L1 inclined from the state of drawing 2
[Drawing 7] Drawing showing signs that leveling-up work was done from the state of drawing 6
[Drawing 8] Drawing for explaining the leveling-up mechanism of the laser survey equipment by the 2nd operation gestalt of this invention
[Drawing 9] Drawing showing signs +deltaomega** That the beam shaft of a laser beam L1 inclined from the state of drawing 8
[Drawing 10] Drawing showing signs that leveling-up work was done from the state of drawing 9
[Drawing 11] The cross section showing the structure of the beam shaft controller 63 in the laser survey equipment of the 3rd operation gestalt of this invention
[Drawing 12] The cross section showing the structure of the laser survey equipment of the conventional technology
[Description of Notations]
21 Laser Diode
22 Collimator Lens
24 Beam Splitter
27 Pentaprism
28 Condenser Lens
29 Two-dimensional PSD
31, 32, 61, 62 Tilt sensor
33 63 Beam shaft controller
35 53 Control section
41 42 Abbreviation parallel glass
43 Covering
44 Solution Layer
45 46 Glass presser-foot frame
45b, 46b Lead screw attaching part
47 Pin
48 Lead Screw
51 Motor
52 Motor Gear
53 Lead Screw Gear

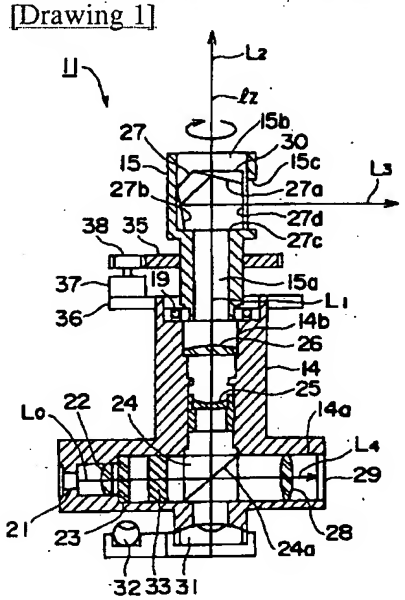
64 65 Wedge glass
L1, L2, L3, and L4 Laser beam
theta Vertical angle

[Translation done.]

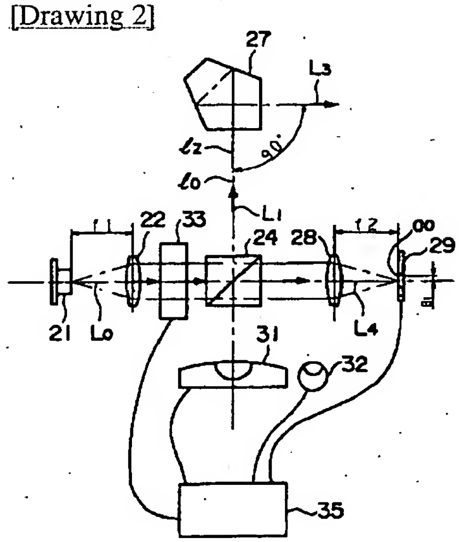
* NOTICES *

DRAWINGS

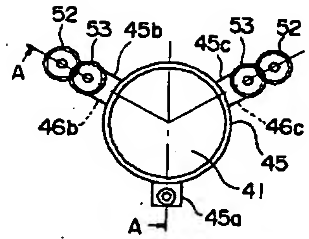
[Drawing 1]



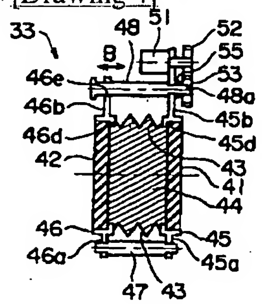
[Drawing 2]



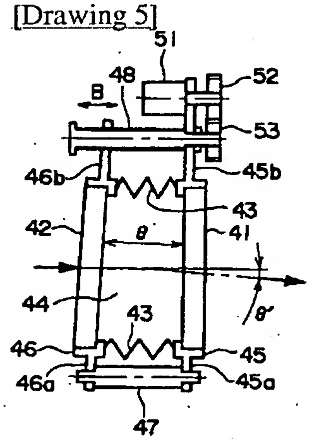
[Drawing 3]



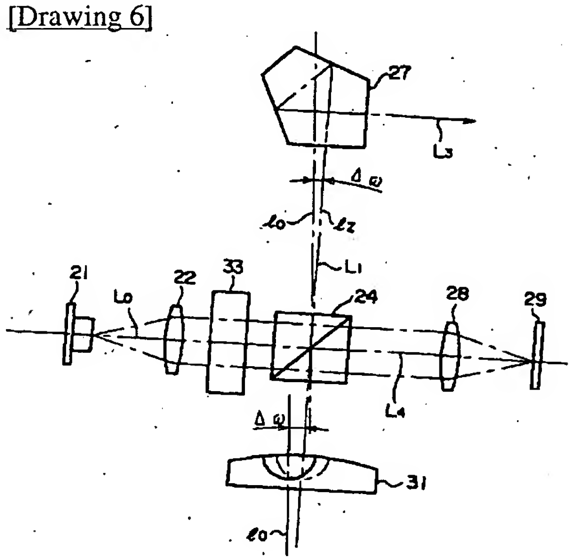
[Drawing 4]



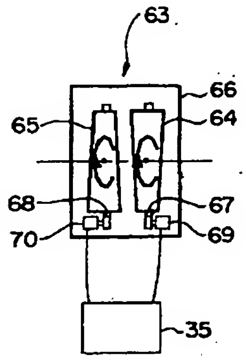
[Drawing 5]



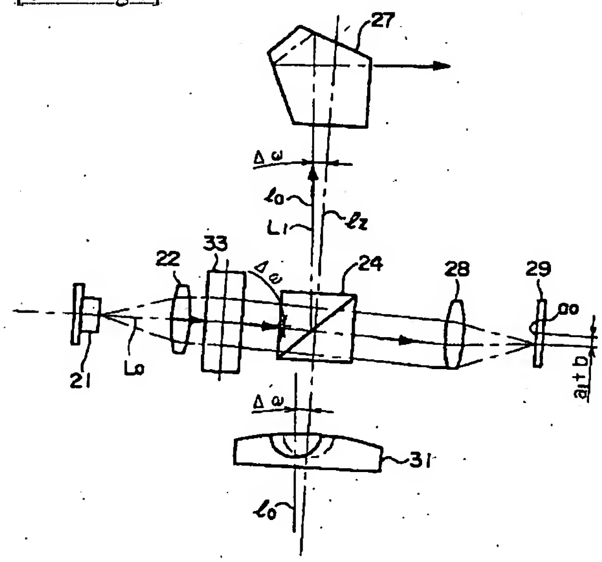
[Drawing 6]



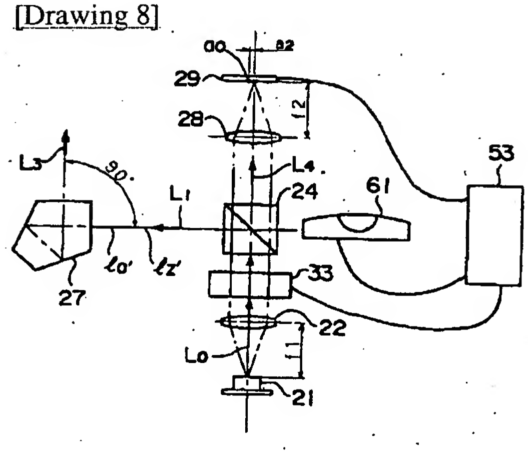
[Drawing 11]



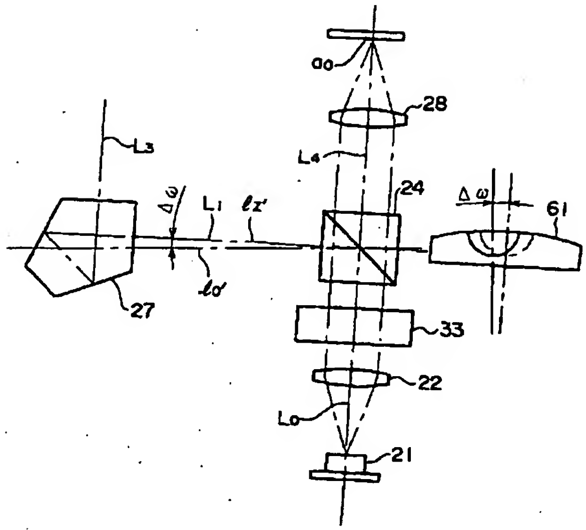
[Drawing 7]



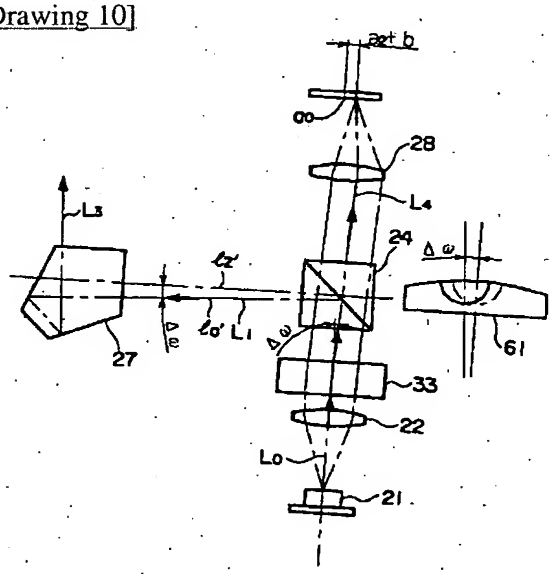
[Drawing 8]



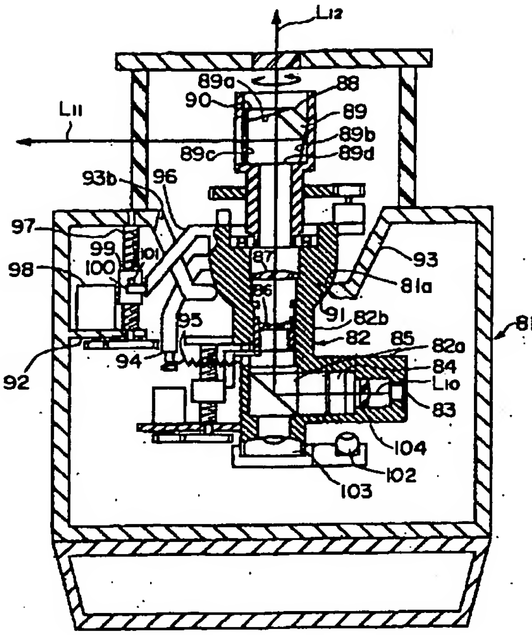
[Drawing 9]



[Drawing 10]



[Drawing 12]



[Translation done.]